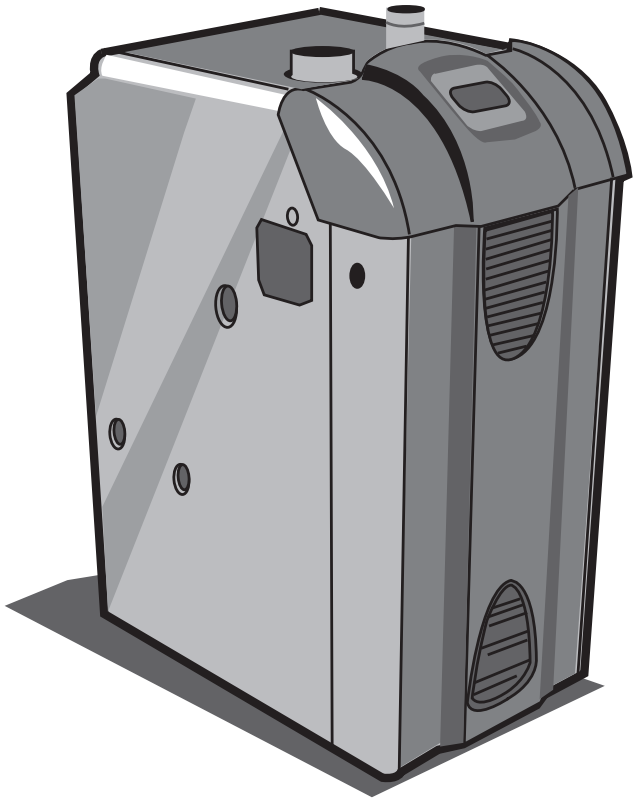
INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

ESC™

ENHANCED SEALED COMBUSTION

Gas - Fired Boiler



As an ENERGY STAR® Partner, U.S. Boiler Company has determined that this boiler meets the ENERGY STAR® guidelines for energy efficiency established by the United States Environmental Protection Agency (EPA).

For service or repairs to boiler, call your heating contractor. When seeking information on boiler, provide Boiler Model Number and Serial Number as shown on Rating Label.

Boiler Model Number	Boiler Serial Number	Installation Date
ESC		
Heating Contractor		Phone Number
Address		

U.S. Boiler Company

102601-01 - 4/11

Price - $5.00

WARNINGS FOR THE HOMEOWNER

FOLLOW ALL INSTRUCTIONS and warnings printed in this manual and posted on the boiler.

INSPECT THE BOILER ANNUALLY. To keep your boiler safe and efficient, have a service technician follow the Service checklist near the end of this manual.

IF YOU ARE NOT QUALIFIED to install or service boilers, do not install or service this one.

THE BOILER MAY LEAK WATER at the end of its useful life. Be sure to protect walls, carpets, and valuables from water that could leak from the boiler.

PROTECT YOUR HOME IN FREEZING WEATHER. A power outage, safety lockout, or component failure will prevent your boiler from lighting. In winter, your pipes may freeze and cause extensive property damage. If you must leave your home unattended for an extended time when outdoor temperatures are below 32°F, first turn off your home's main water supply and drain the water from all pipes.

DO NOT BLOCK AIR FLOW into or around the boiler. Insufficient air may cause the boiler to produce carbon monoxide or start a fire.

KEEP FLAMMABLE LIQUIDS AWAY from the boiler, including paint, solvents, and gasoline. The boiler may ignite the vapors from the liquids causing explosion or fire.

KEEP CHILDREN AND PETS away from hot surfaces of the boiler, boiler piping, and vent pipe.

CARBON MONOXIDE (CO) is an odorless, deadly gas that may be introduced into your home by any malfunctioning fuel-burning product, including your boiler. Consider installing CO alarms near bedrooms in all levels of the building to warn you and your family of potential CO exposure.

WARNINGS FOR THE INSTALLER

READ THIS ENTIRE MANUAL before attempting installation, start-up, or service. Improper installation, adjustment, alteration, service, or maintenance may cause serious property damage, personal injury, or death.

DO NOT DISCONNECT PIPE FITTINGS on the boiler or in the heating system without first verifying that the system is cool and free of pressure and that your clothing will protect you from a release of hot water or steam. Do not rely solely on the boiler's temperature and pressure gage when making this judgment.

USE PROPER PERSONAL PROTECTION EQUIPMENT when servicing or working near the boiler. Materials of construction, flue products, and fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, and/or other toxic or harmful substances that can are hazardous to health and life and that are known to the State of California to cause cancer, birth defects, and other reproductive harm.

INSTALL ALL GUARDS, cover plates, and enclosures before operating the boiler.

SIZE THE BOILER PROPERLY relative to the heat load. A grossly oversized boiler will cycle excessively and this will lead to premature failure of the boiler and its components. Our warranty does not apply to damage from excessive cycling.

ADHERE TO ALL LOCAL CODE REQUIREMENTS. Contact your local code inspector prior to installation. In the absence of a local code, adhere to the National Fuel Gas Code ANSI Z223.1/NFPA 54 or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

ALL WIRING must comply with the National Electrical Code ANSI/NFPA 70 (in the USA) or the Canadian Electrical Code CSA C22.1 (in Canada) and any local regulations.

IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR to see that all controls are correctly installed and are operating properly when installation is complete including verifying that the limit sensor is fully installed.
Failure to properly install Limit Sensor may result in property damage, personal injury or loss of life due to elevated operating temperatures and/or pressures.

Special Installation Requirements for Massachusetts

A. For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes and where the side wall exhaust vent termination is less than seven (7) feet above grade, the following requirements shall be satisfied:

1. If there is no carbon monoxide detector with an alarm already installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code in the residential unit served by the side wall horizontally vented gas fueled equipment, a battery operated carbon monoxide detector with an alarm shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code.
2. In addition to the above requirements, if there is not one already present, a carbon monoxide detector with an alarm and a battery back-up shall be installed and located in accordance with the installation requirements supplied with the detector on the floor level where the gas equipment is installed. The carbon monoxide detector with an alarm shall comply with 527 CMR, ANSI/UL 2034 Standards or CSA 6.19 and the most current edition of NFPA 720. In the event that the requirements of this subdivision can not be met at the time of the completion of the installation of the equipment, the installer shall have a period of thirty (30) days to comply with this requirement; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the carbon monoxide detector may be installed on the next adjacent habitable floor level. Such detector may be a battery operated carbon monoxide detector with an alarm and shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code.
3. A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, **"GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS"**.
4. A final inspection by the state or local gas inspector of the side wall horizontally vented equipment shall not be performed until proof is provided that the state or local electrical inspector having jurisdiction has granted a permit for installation of carbon monoxide detectors and alarms as required above.

B. EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a) 1 through 4:

1. The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and
2. Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

C. When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions for installation of the equipment and the venting system shall include:

1. A complete parts list for the venting system design or venting system; and
2. Detailed instructions for the installation of the venting system design or the venting system components.

D. When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting flue gases, but identifies "special venting systems", the following shall be satisfied:

1. The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and
2. The "special venting systems" shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

E. A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

Congratulations on your purchase of a new ESC™ boiler—designed and constructed to provide you with years of reliable service.

- *ENERGY STAR™ efficiency* – friendly on the environment and your wallet.
- *Cast iron heat exchanger* – for reliability and durability, nothing beats a cast iron heat exchanger made at Burnham Foundry, LLC in Zanesville, Ohio.
- *IQ Control*™ – the most advanced and easiest to use control available.
- *System-friendly* – built-in protection from condensation and thermal shock.

What's in the crate?

1. ESC™ Boiler
2. Circulator & Gasket Kit
   - ❑ Taco 007-2 (8056170)
   - ❑ Grundfos UP-15 (102805-01)
   - ❑ B & G NRF-22 (8056174)
3. Miscellaneous Parts Carton

   Cartons Include:

   (1) Safety Relief Valve, Set at 30 PSI
   (1) Pressure/Temperature Gauge
   (1) Water Manifold
   (1) Circulator Harness
   (1) Vent Connector
   (1) Vent Terminal
   (1) Air Intake Terminal
   (1) Drain Valve

   - ❑ ESC3/ ESC4: P/N 102648-01
   - ❑ ESC5/ ESC 6: P/N 102648-02
   - ❑ ESC7: P/N 102648-03
   - ❑ ESC8/ ESC9: P/N 102648-04
4. Instruction Envelope (102656-01)
   - ❑ Instruction & Operation Manual (102601-01)
   - ❑ Hydronics Institute Instructions (81460061)
   - ❑ Warranty Sheet (103203-01)
   - ❑ Warranty Card, (103204-01
   - ❑ Equipment List (103586-01)

SPECIFICATIONS

Ratings

ESC Series

Boiler Model	Input (MBH)	Output (MBH)	Net I=B=R Water (MBH)	AFUE (%)
ESC3	70	60	52	85.5
ESC4	105	90	78	85.4
ESC5	140	120	104	85.3
ESC6	175	150	130	85.2
ESC7	210	179	156	85.0
ESC8	245	208	181	84.5*
ESC9	280	238	207	84.0*

* Do not meet ENERGY STAR requirements

Electrical Requirements: 120VAC, 60 Hz, 1-ph, 15A

Dimensions, Weights and Connections

Boiler Model	Depth	Width	Height	Supply NPT (inch)	Return NPT (inch)	Vent (inch)	Air Intake (inch)	Gas NPT (inch)	Relief Valve NPT (inch)	Drain IPS (inch)
ESC3	33	12¾	41	1¼	1¼	3	3	½	¾	¾
ESC4	33	15½	41	1¼	1¼	3	3	½	¾	¾
ESC5	33	18½	41	1¼	1¼	3	4	½	¾	¾
ESC6	33	21½	41	1¼	1¼	3	4	½	¾	¾
ESC7	33	24¾	41	1¼	1¼	3	5	¾	¾	¾
ESC8	33	27¾	41	1¼	1¼	4	5	¾	¾	¾
ESC9	33	30¾	41	1¼	1¼	4	5	¾	¾	¾

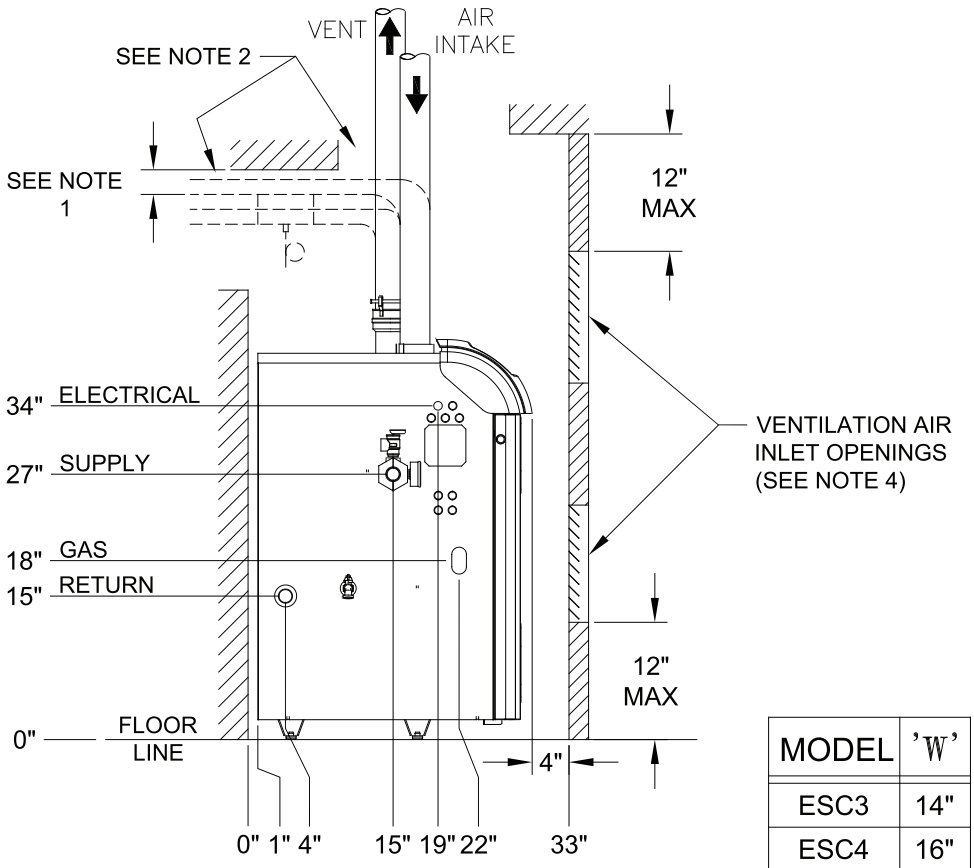
Water Temperatures and Flows

Boiler Model	Allowable Supply Water Temperature (°F)	Minimum Return Water Temperature (°F)	Minimum Flow (GPM)	Waterside Pressure Drop at 20°F ΔT (Ft. of Head)
ESC3	130-220	110	None	<1
ESC4	130-220	110	None	<1
ESC5	130-220	110	None	<1
ESC6	130-220	110	None	<1
ESC7	130-220	110	None	<1
ESC8	130-220	110	None	<1
ESC9	130-220	110	None	<1

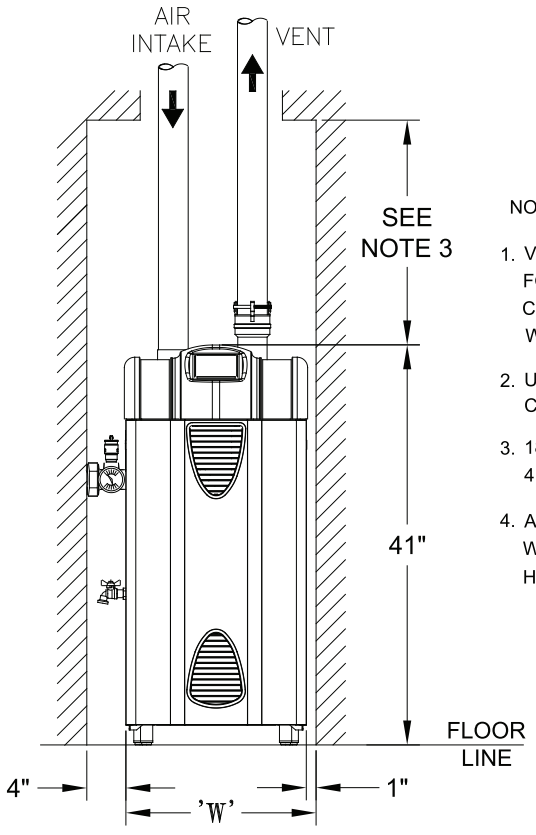
Weights and Volume

Boiler Model	Shipping Weight (lbs)	Empty Weight (lbs)	Water Content (gal)
ESC3	250	170	2
ESC4	300	220	3
ESC5	350	270	4
ESC6	410	320	5
ESC7	460	370	5
ESC8	510	420	6
ESC9	560	470	7

SPECIFICATIONS (continued)



MODEL	'W'
ESC3	14"
ESC4	16"
ESC5	19"
ESC6	22"
ESC7	25"
ESC8	28"
ESC9	31"



NOTES:

1. VENT PIPE MINIMUM CLEARANCE TO COMBUSTIBLE MATERIAL IS FOUR (4) INCHES WHEN VENT IS INSTALLED IN A FULLY ENCLOSED CHASED APPLICATION OR THREE (3) INCHES WHEN VENT IS INSTALLED WITH AT LEAST ONE SIDE OPEN, SIMILAR TO A JOIST BAY APPLICATION.
2. USE DOUBLE WALL THIMBLE WHEN PENETRATING A COMBUSTIBLE WALL.
3. 18 INCH CLEARANCE REQUIRED FOR CLOSET INSTALLATION. 4 INCH CLEARANCE REQUIRED FOR OPEN INSTALLATION.
4. AREA OF EACH OPENING, 1 SQ. INCH FOR EACH 1000 BTUH INPUT WITH A MINIMUM OF 100 SQ. INCHES. HEIGHT OF OPENING SHOULD BE HALF THE WIDTH.

Figure S-1: Minimum Clearances to Combustibles

BOILER QUICK-START

Installation:

1. Unpack the crate 8
2. Position the boiler 8
3. Provide combustion air 9
4. Connect venting 9
5. Connect gas piping 11
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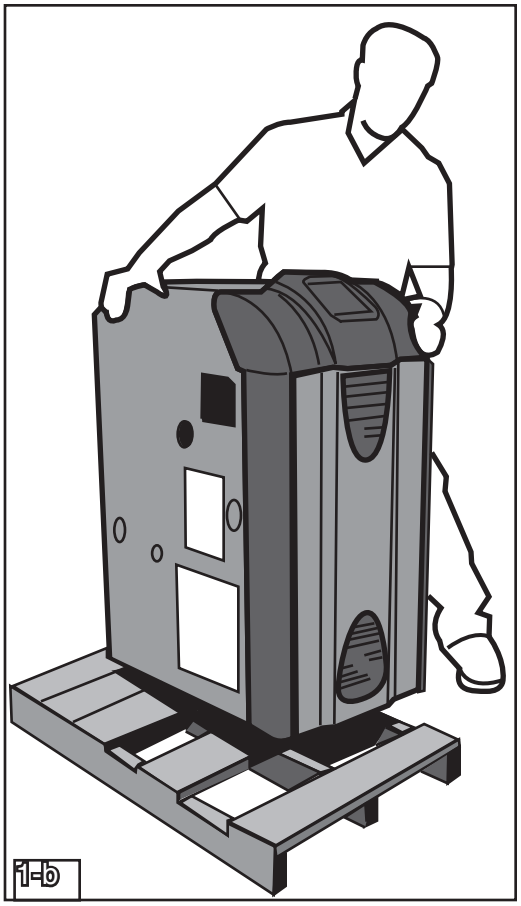
1. UNPACK THE CRATE

THE BOILER IS TOP-HEAVY. Do not allow it to tip over.

1. Remove the sleeve.
2. Remove the contents from the skid, except the boiler.
3. Remove the four (4) hex-drive lag screws holding the boiler to the skid (Figure 1-a).

4. Tip the boiler and shimmy it off the skid.



2. POSITION THE BOILER

WARNINGS

OBSERVE MINIMUM CLEARANCES to combustible walls and ceilings to avoid potential fire hazard.

DO NOT INSTALL ON CARPET. This may cause a fire.

INSTALLING THE BOILER NEAR A SOURCE OF FLAMMABLE LIQUIDS or gases may cause fire or explosion.

CLEAN BURNERS DAILY if operating the boiler in a dusty environment.

PROTECT IGNITION SYSTEM COMPONENTS from sources of water that may spray, drip, or rain on them during installation or service.

1. Slide the boiler into desired location.
2. Meet the minimum clearances to combustible construction per the *Specification* Section of this manual.
3. Allow 24" service clearance in front and on the left side of the boiler.
4. Level the boiler, using shims as necessary.

3. PROVIDE COMBUSTION AIR

INSUFFICIENT COMBUSTION AIR SUPPLY may result in the production and release of deadly carbon monoxide (CO) into the home.

Like all fuel-burning appliances, boilers need air to operate reliably and safely.

1. If equipping for direct vent (sealed combustion), provide combustion air according to *Appendix B2—Venting for Direct Vent boilers*.
2. If not equipping the ESC for direct vent, provide combustion air from the boiler room according to *Appendix A—Combustion Air.*

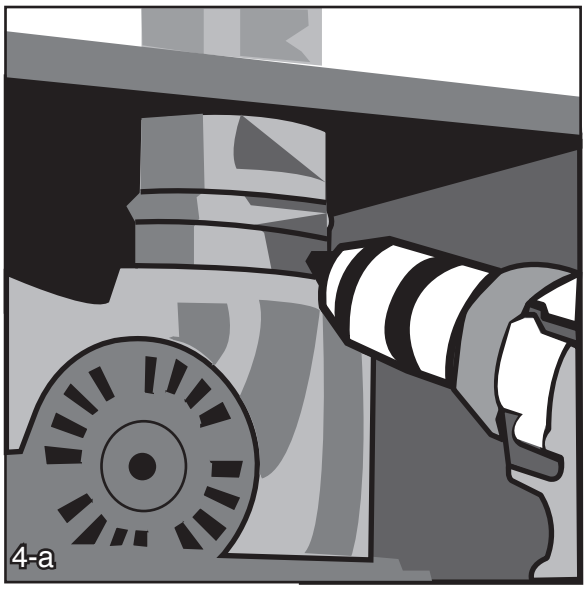
4. CONNECT VENTING

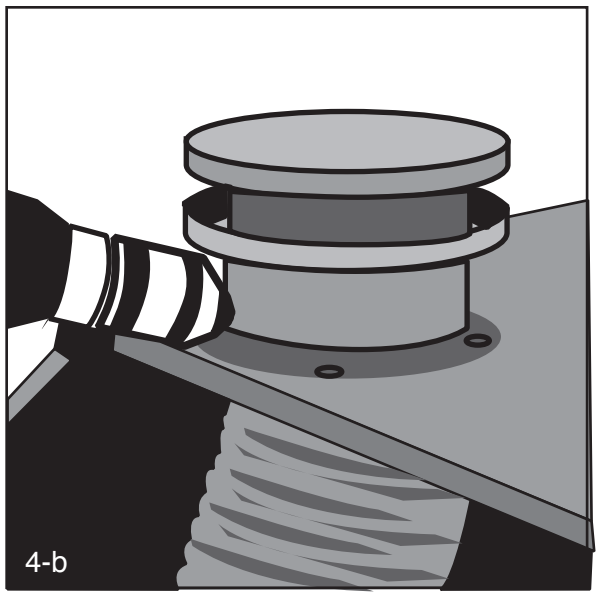
IMPROPER VENTING may result in property damage and the release of deadly carbon monoxide (CO) into the home.

Observe all general venting guidelines provided in *Appendix B—Venting.* Additionally:

Follow all instructions in *Appendix B-2 Direct Vent* or *B-3 Power Vent*.

1. For the exhaust, attach special (Category IV) gas vent to the fan outlet using a single sheetmetal screw (Figure 4-a).
2. Configure the air intake:
   (1) To equip the ESC for outdoor combustion air (direct vent), attach the plastic or metal intake air pipe to the inlet air duct.
   (2) To equip the ESC for indoor combustion air (power vent), attach the air intake terminal to the boiler's inlet air duct with a single sheetmetal screw (Figure 4-b).
3. For horizontal venting, follow the instructions in *Appendix B2 —Direct Venting, Special Instructions for Stainless Steel Venting —Horizontal Installations,* Specifically,
   (1) Cut a hole in the exterior wall, large enough to fit the wall thimble. Hole diameter for the ESC3-7 is 7", hole diameter for the ESC8-9 is 8".
   (2) Install wall thimble.


4-a


4-b

4. CONNECT VENTING (continued)

(3) Install vent piping.

(4) When configuring the ESC for Power Vent (indoor combustion air) install a 45° vent elbow, pointing downward.

(5) Install vent terminal and seal around all exterior openings.

(6) The final installation should appear as in Figure 4-c.

4. For vertical venting, follow instructions in *Appendix B2 — Direct Venting, Special Instructions for Stainless Steel Venting —Vertical Installations,* Specifically,

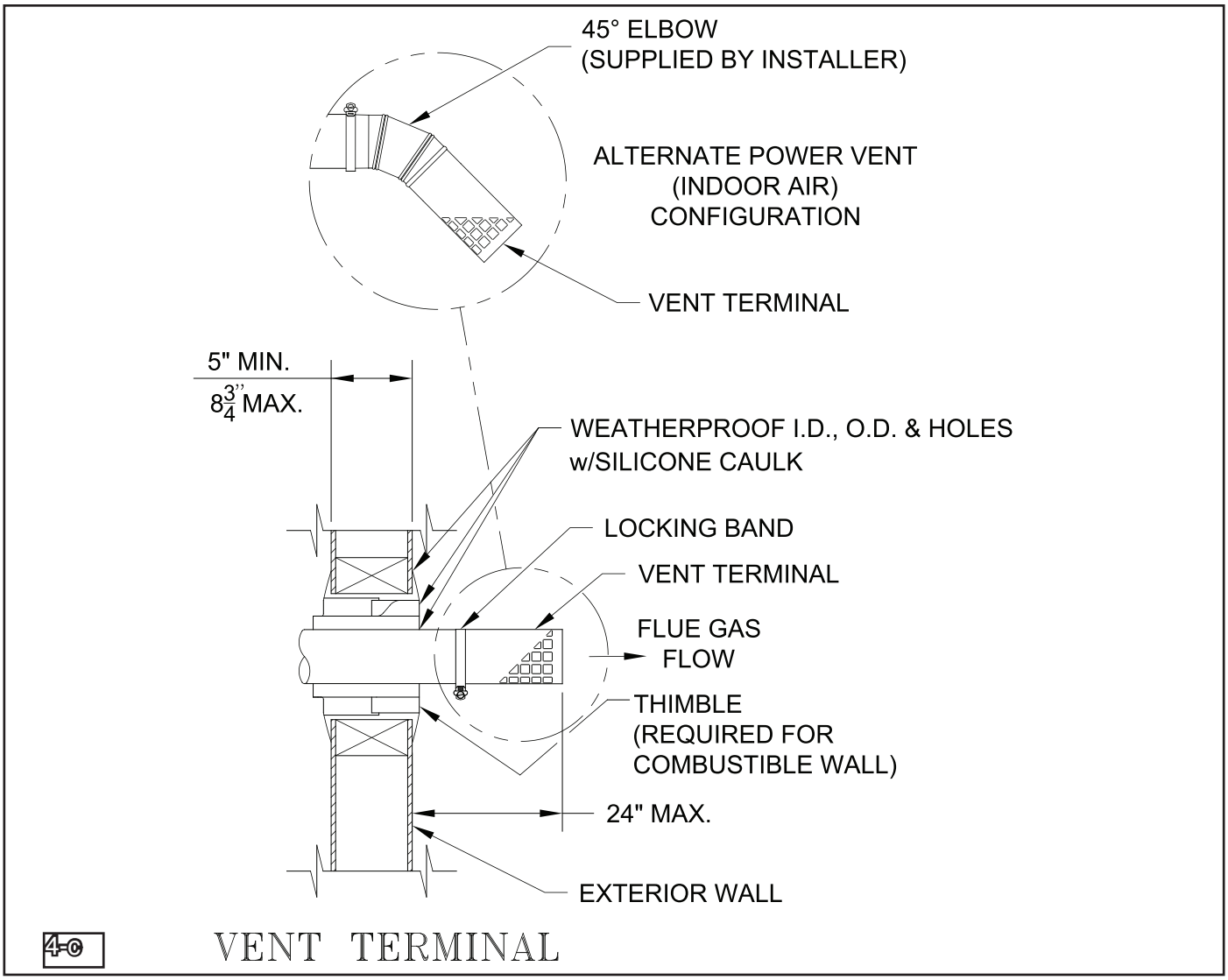
(1) Install fire stops and wall thimbles.

(2) Install vent piping and vert terminal.

(3) Install condensate line.

(4) Install roof flashing and roof supports.

(5) The final installation should appear as in Figure B-7 in *Appendix B-2*.



4-0 VENT TERMINAL

5. CONNECT GAS PIPING

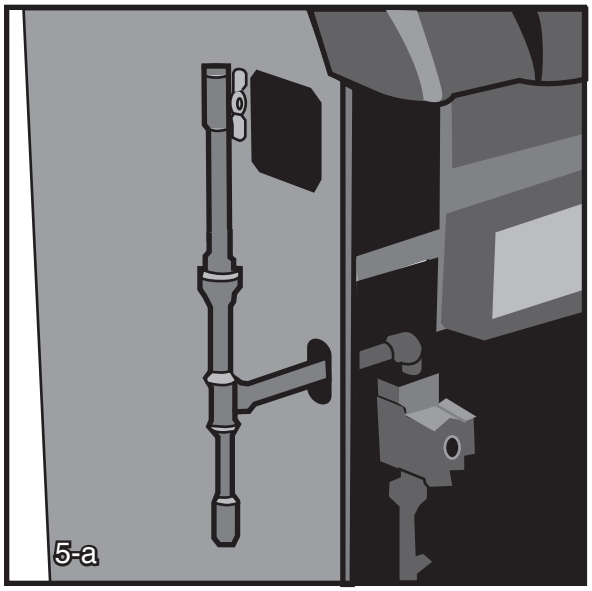
Size gas piping according to *Appendix C – Gas Piping*

SHUT OFF GAS SUPPLY before servicing the boiler.

ALL GAS PIPING MUST BE GAS TIGHT. Use gas rated thread compound on all threaded joints to avoid leaks, which may result in fire or explosion.

SIZE GAS PIPING, regulators, valves, and meters so as to provide an adequate gas flow and pressure to the boiler during operation. Failure to do so may cause poor combustion, noise, injury, or death.

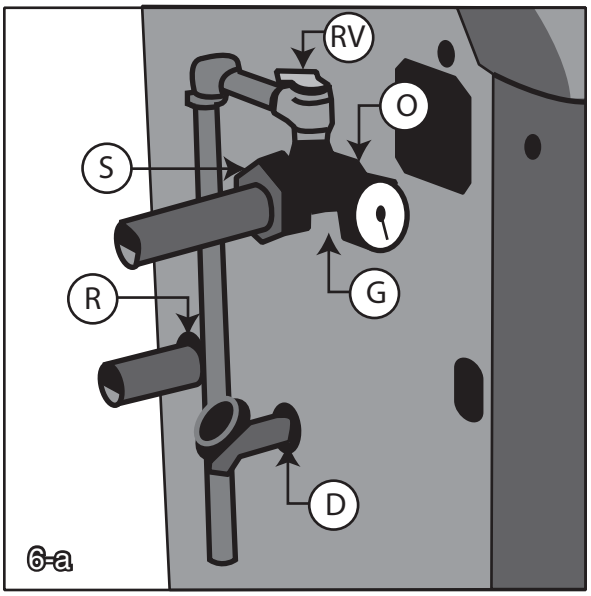
1. Remove boiler door, locate gas valve and remove plastic shipping plug.
2. Thread a ¾" x 1½" nipple, a 90° street elbow, or a Honeywell flange onto the gas valve and pipe through the slot in the left jacket panel (Figure 5-a). In Canada, close nipples and street ells are not approved for use as gas piping.
3. Pipe from the street elbow through the left jacket panel, and complete drip leg as shown (Figure 5-a).



6. CONNECT BOILER WATER PIPING

General system piping guidelines are included in *Appendix D—System Piping.*

Additionally, for this particular boiler install piping shown below (Figure 6-a).



1. Apply sealant to all threads.
2. Screw the water supply manifold into the boiler outlet tapping “O.”
3. Orient the manifold with the relief valve on top.
4. Screw the relief valve into manifold tapping “RV”.

This installation is not complete until the relief valve is installed.

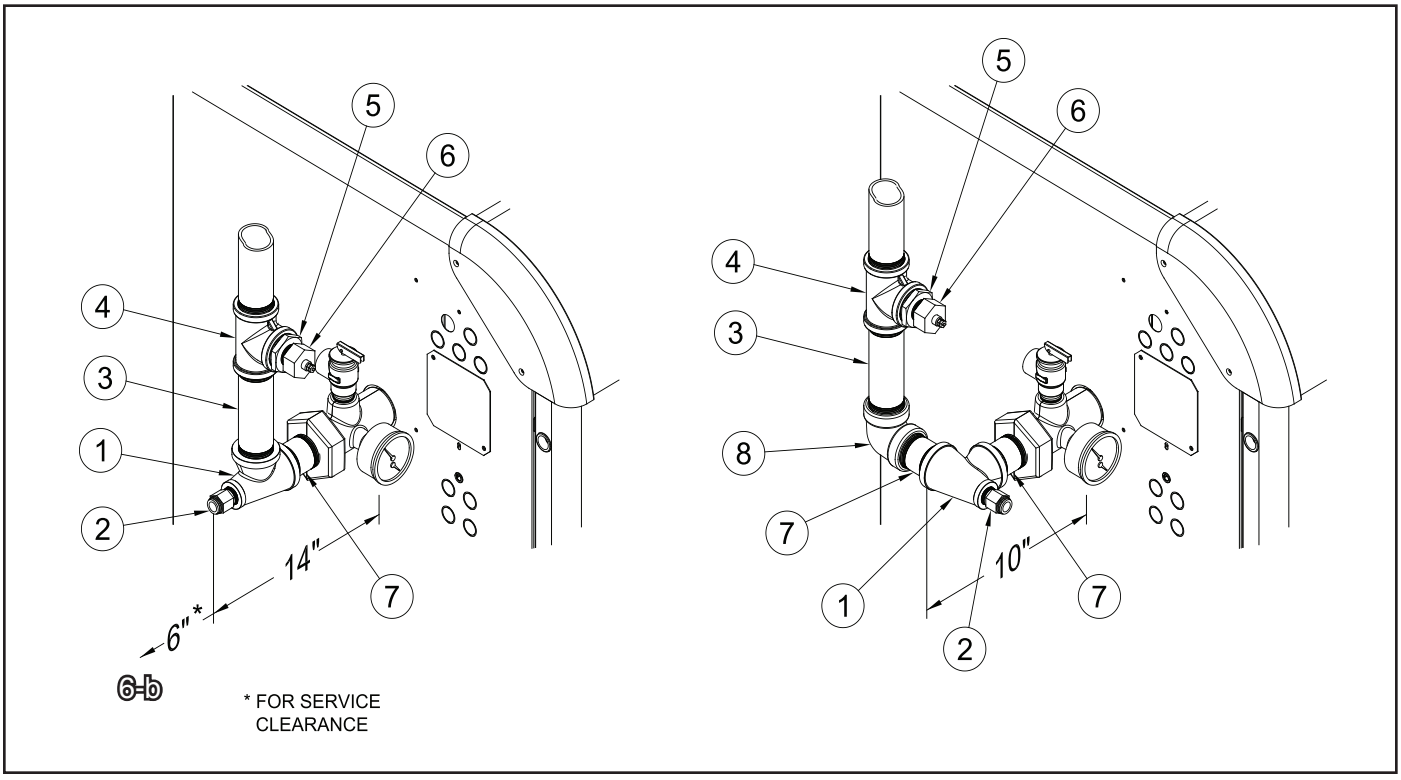
PIPE THE RELIEF VALVE DISCHARGE to a location where it will not harm people or damage property. The relief valve may discharge scalding hot water or steam.

BLOCKING THE RELIEF VALVE may result in boiler explosion.

5. Screw the temperature-pressure gage into manifold tapping “G”.

6. CONNECT BOILER WATER PIPING (continued)

6. Connect the system supply to the open end of the manifold "S" using a 1¼” male NPT fitting.
7. Screw an installer-supplied 1¼” pipe or nipple into the water return tapping “R”.
8. Screw the supplied drain valve into tapping “D”.
9. See Figure 6b for suggested near boiler piping of IQ Options.



Item	Description	Part Number
1	1¼ x 1¼ x ½ Tee	806601021
2	Immersion Well, ½ NPT	80160456
3	1¼ x 6 Nipple	806600029
4	1¼ Tee	806601030
5	1¼ x ¾ Bushing	806600504
6	LWCO Sensor, ¾ NPT	102305-01
7	1¼ x 3 Nipple	806600005
8	1¼ Elbow	806601528

7. CONNECT ELECTRICAL WIRING

DISCONNECT ELECTRICAL POWER to the boiler and heating system before servicing. Positively assure that no voltage is present. Lock electrical boxes to prevent someone from inadvertently restoring power before the heating system is safe to operate.

NEVER DEFEAT OR JUMP OUT safety devices.

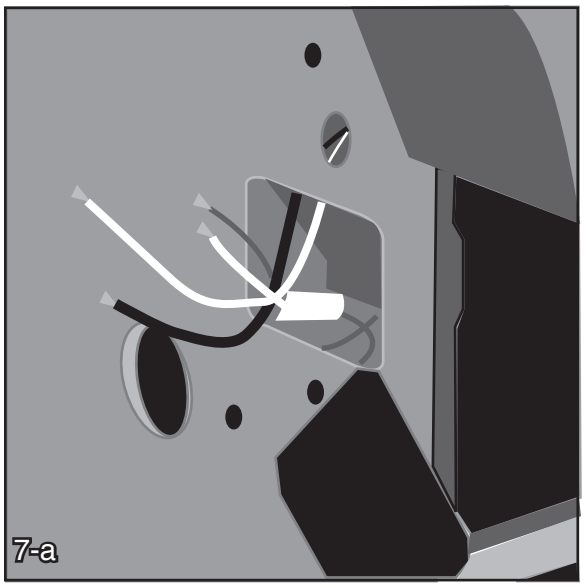
PROTECT EACH BOILER circuit with a properly sized over-current protection device.

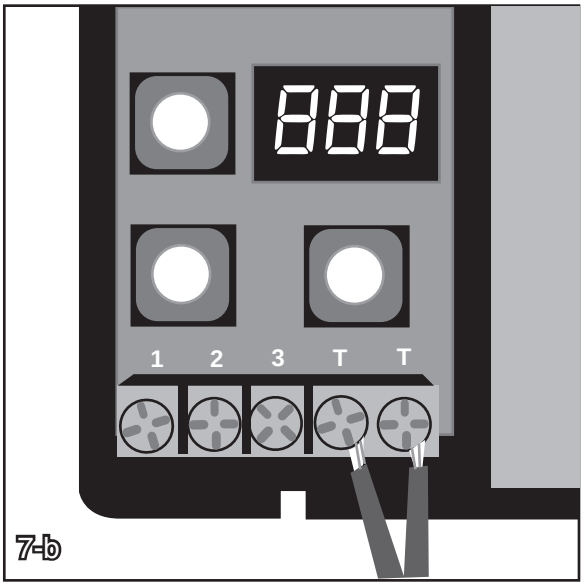
MAKE ELECTRICAL CONNECTIONS CAREFULLY according to the boiler's wiring diagram and instructions

Refer to the *Internal Wiring* diagrams later in this manual.

1. Locate the wiring box on the left side of the boiler and open the cover (Figure 7-a).
2. Install a 120V disconnect near the boiler.
3. Connect the 120V wiring from the disconnect to the boiler's white (neutral), black (hot), and green (ground) labeled "120VAC Power supply". Do not reverse polarity.
4. Connect the 120V wiring from the circulator to the white (neutral) yellow (hot) wires marked "circulator".

WIRE AN ADDITIONAL SAFETY LIMIT such as a low water cutoff or temperature limit device, other than an IQ™ Control device, in series with the 120V circuit used to power the boiler. Do not alter the boiler's factory wiring when adding an additional limit.


7-a



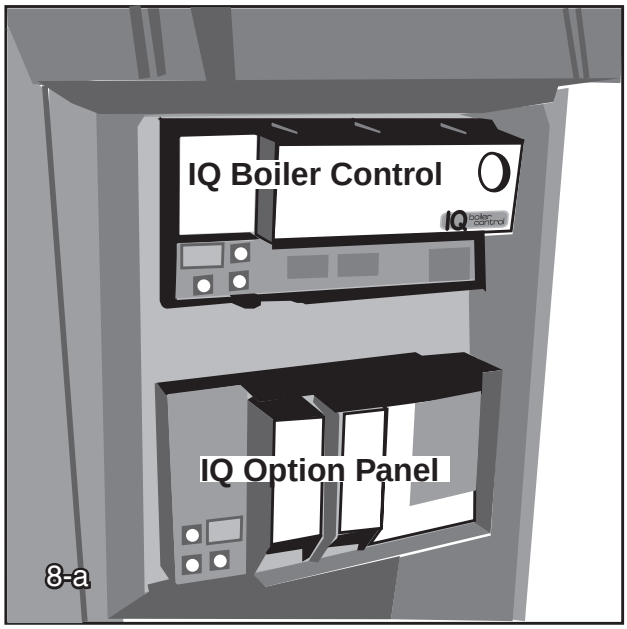
7-b

5. Connect the 24V wiring from the thermostat to the "T-T" terminals on the Option Control Panel.
6. To connect other external devices, refer to the instructions included with these devices.

8. PROGRAM THE CONTROLS

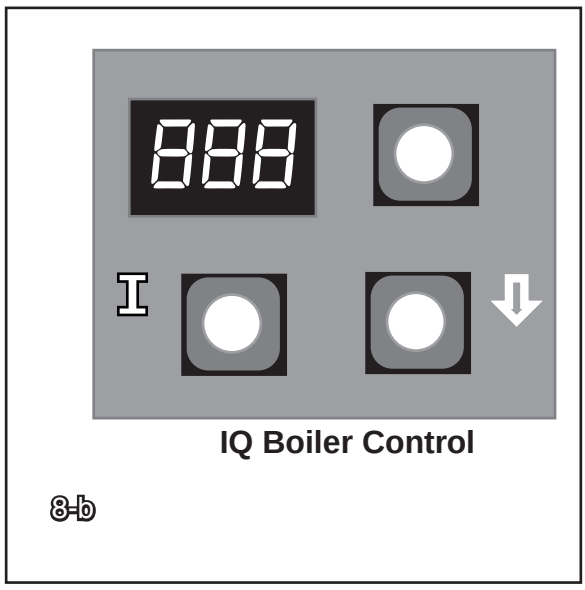
Using IQ Boiler Control Display

The IQ Boiler Control is located inside the boiler front door, just above the IQ Option Panel (Figure 8-a).



8-a

The IQ Boiler Control display, along with Up ⇧, Down ⇩, and "I" keys may be used to view boiler operating status (Figure 8-b). Please note that these keys look similar to the keys on the IQ Option Panel but are in a different orientation, and they perform different functions.



8-b

Viewing the Operating Mode Options

In operating mode the user may view (but not change) boiler operating status, settings and troubleshooting information. To view IQ Boiler Control display information:

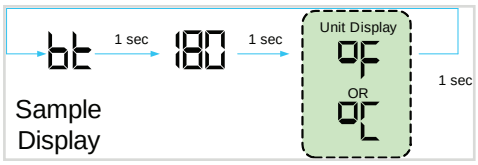
1. Press and release the "I" key on the IQ Boiler Control to change from one parameter to the next. Each setting will alternately flash between the relevant display code and its corresponding value.

Operating Mode Options	
StA	Status
bt	Boiler Temperature
SP	Operating Setpoint (Outdoor Reset)
HL	High Limit Setting
HdF	High Limit Differential
hr	Heat Request Status
FLA	Flame Current
run	Run Time Hours
CYC	Boiler Cycles
Err	Error (see Error Numbers)

Status Code Displayed in StA Mode	
1	Standby: Either TT Open or TT Closed and Boiler Temperature within Setpoint and Differential with Circulator Running.
2	Waiting for Pressure Switch to Open
3	Waiting for Pressure Switch to Close
4	Prepurge
6	Spark
7	Flame Proving
8	Running
9	Postpurge
10	Retry/Recycle Delay
11	Pressure Switch Failed to Open
12	Pressure Switch Failed to Close
13	Soft Lockout
14	Hard Lockout
15	Waiting for Limit to Close
16	Flame Present Out of Sequence
17	Self Test

For example, when the "I" key is pressed on the IQ Boiler Control until "bt" is displayed, it will then flash a three digit number (such as " 180") followed by either "F" (or "C"). This indicates that the boiler water temperature is 180°F. Other operating parameters display the information in a similar fashion.

8. PROGRAM THE CONTROLS (continued)



Please note that in operating mode to hold the display on the value the user can press and hold either the Up ⇧ or Down ⇩ keys and the value will be continuously shown. This may be helpful in watching a value “live”.

Changing the Adjustable Parameters

To adjust the High Limit setpoint, High Limit Differential or Pump Overrun time settings or setting the display for either °F or °C temperature readings:

1. Access the adjustment mode by pressing and holding the Up ⇧, Down ⇩, and “𝙸” keys simultaneously for three (3) seconds. This procedure is intended to discourage unauthorized changes or accidental changes to limit settings.
2. Press the "𝙸" key to display available Adjustment Mode options. Select an option.

Adjustment Mode Options	
HL_	Adjust High Limit Setting
dF_	Adjust High Limit Differential
Or_	Pump Overrun Time (minutes)
rSt	Reset Lockout
F-C	Select degrees F or C Mode
bAc	Back to Operating Mode

3. Press the Up ⇧ and Down ⇩ keys to adjust the displayed setpoint to the desired value.
4. To return to the normal operating mode from the Adjustment Mode, when the "bAc” option is displayed, press either the Up ⇧ or Down ⇩ key. If no keys are pressed, after five (5) minutes the IQ Boiler Control will automatically return to the Operating Mode.

More Information about Adjustable Parameters

1. High Limit (HL_)
   The IQ Control is factory programmed with a High Limit Setpoint of 180°F. The boiler turns "off" when the supply water temperature is above this value. The High Limit setpoint is adjustable between 130° and 220°F. The Operating Setpoint (SP) will equal the High Limit Setpoint unless an IQ Outdoor Reset IQ Option Card is installed. The Outdoor Reset IQ Option Card reduces the Operating Setpoint to regulate heat delivery, increase home comfort and save energy. Refer to the *Appendix H* for additional information.
2. Differential (dF_)
   The IQ Boiler Control is factory programmed with a Differential of 15°F. The Differential is the number of degrees the supply temperature must decrease below the Operating Setpoint before the boiler can restart. The differential is adjustable between 10° through 30°F.
3. Pump Overrun Time (Or_)
   The IQ Boiler Control is factory programmed with a Pump Overrun Time of 0 minutes. Pump Overrun Time (also called “off delay” or “post purge”) continues pump operation after a call for heat has ended, sending excess heat from the boiler into the priority zone. Ensure system piping and zone panel settings allow water flow to the priority zone after the call for heat ends. The Pump Overrun Time is adjustable between 0 through 10 minutes.

Using the IQ Option Panel

IQ Option Cards are available from Burnham product distributors and are the simplest way to add functionality, safety and efficiency to your heating system. The IQ Option Panel provides an easy and convenient means to "plug-in" an Auxiliary High Limit, Low Water Cut-off and/or Outdoor Reset function.

For installation, programming, and troubleshooting instructions, refer to the instructions supplied with those cards.

8. PROGRAM THE CONTROLS (continued)

Using the Optional LCD Display Kit

The LCD Display is an easy to use touch screen type display that allows a technician to monitor and adjust the IQ Boiler Control and connected IQ Option Cards. All boiler settings, status and error codes are displayed in full text. All Outdoor Reset IQ Option Card parameters are adjustable with graphic and help information screens. The LCD Display Kit includes a mounting bracket and wiring harness to allow mounting in the ESC plastic hood above the front door. For installation, programming, and troubleshooting instructions, refer to the instructions supplied with the display.

9. CHECK FOR GAS AND WATER LEAKS

GAS LEAKS may result in fire or explosion.

WATER LEAKS may cause extensive property damage.

Refer to *Appendix E – Filling the System and Checking for Leaks*

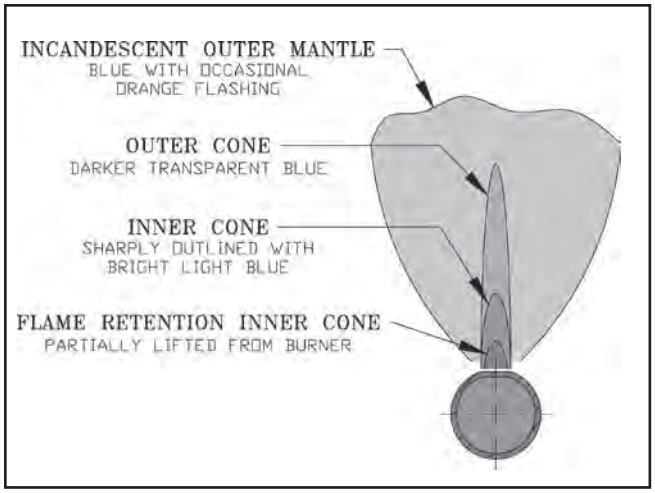
10. PERFORM STARTUP CHECKS AND ADJUSTMENTS

FAILURE TO PERFORM THESE CHECKS of the boiler's combustion and safety systems may result in serious property damage, injury, or death.

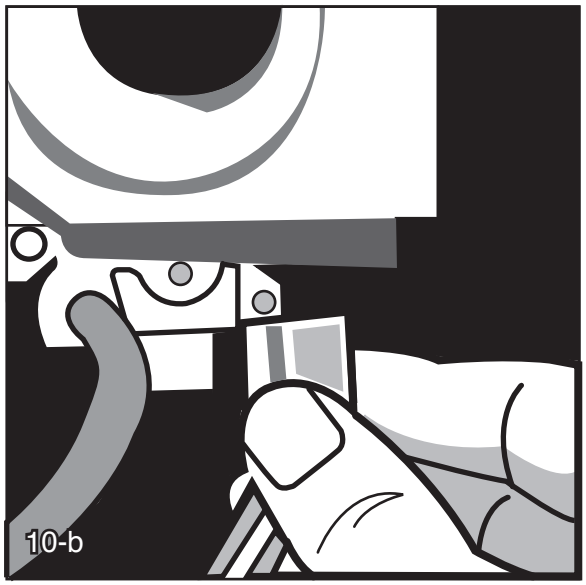
IF YOU SMELL GAS, STOP and repair the leak. Lighting the boiler when gas is leaking may cause explosion or fire.

Follow the checklist below:

1. Verify that the venting, water piping, gas piping, and electrical systems are properly installed and checked.
2. Apply power to the boiler.
3. Adjust zone thermostat to maximum setting.
4. Allow gas line to purge of air.
   - ❑ *Boiler lights cleanly within 60 seconds.*
5. Adjust gas input rate. See *Appendix F – Adjusting Gas Input Rate*



   - ❑ *Pilot and main burner flames appear clean and blue.*
6. Disconnect pilot lead wires from gas valve (Figure 10-b).
   - ❑ *Boiler shuts off.*



7. Reconnect pilot lead wires to gas valve.
   - ❑ *Boiler restarts.*
8. Adjust zone thermostat to minimum setting.
   - ❑ *Boiler shuts off.*
9. Adjust zone thermostat to maximum setting.
10. Observe temperature gage as boiler heats.
11. Adjust the high limit setting to its minimum level (see "Programming High Limit" in Section 8).
    - ❑ *Boiler shuts off when temperature gage reads within 15°F of high limit setting.*
12. Return high limit to the desired setting (see "Programming High Limit" in Section 8).
13. Check combustion in the vent stack and record results in the spaces provided below.
    - _____ CO_2 (less than 7%)
    - _____ O_2 (more than 9%)
    - _____ CO (less than 100 ppm, air free)

ANY FAILED STARTUP CHECK Must be corrected before placing the boiler in service.

ANNUAL MAINTENANCE CHECKLIST

WARNINGS

THE BOILER CONTAINS REFRACTORY CERAMIC FIBER, a possible human carcinogen.

USE A NIOSH APPROVED RESPIRATOR when servicing high-temperature insulation and gasket materials. Wash exposed skin gently with soap and water after contact Wash exposed clothing separate from normal laundry.

LABEL ALL WIRES prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation

FAILURE TO MAINTAIN THE BOILER in proper working condition may lead to fire, explosion, personal injury or death, and extensive property damage.

TURN OFF ALL GAS AND ELECTRIC power supplies to the boiler before servicing. Contact with or release of dangerous flammable gas, electrical voltage, moving parts, and very hot water under pressure may cause serious personal injury, property damage, or death.

LOCK ELECTRICAL BOXES AND GAS VALVES CLOSED to prevent someone from inadvertently restoring power or gas before the heating system is safe to operate.

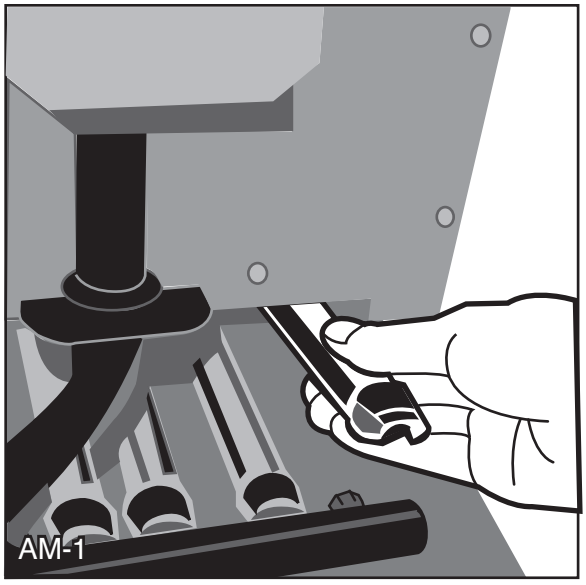
Refer to the information in *Appendix H – Important Product Safety Information* before servicing.

Equipment you will need:

- ❑ Soft bristle brush
- ❑ Bristle flue brush
- ❑ Vacuum with brush attachment

Perform these tasks each year:

1. Clean low water cutoff probe (if applicable).
2. Inspect vent for obstruction and signs of condensation, distortion, overheating or gas leakage.
3. Clean vent terminal and air intake screens.
4. Inspect boiler flue passages:
   (1) Remove vent pipe.
   (2) Remove top panel and hood.
   (3) Remove canopy.
   (4) Examine all flue passageways. Using bristle flue brush and vacuum, remove any soot or obstructions.
5. Remove and clean main burners:
   (1) Remove jacket front panel.
   (2) Disconnect pilot tubing at gas valve.
   (3) Disconnect pilot lead wires at gas valve.
   (4) Remove wires from flame roll-out switch.
   (5) Remove burner access panel.
   (6) Mark location of the pilot main burner on the manifold if the marking on manifold is missing or obliterated.
   (7) Hold burner at throat. Lift front of burner to clear orifice (Figure AM-1). The burner that holds the pilot can only be removed by first lifting the burner adjacent to its right.
6. Perform *Startup Checks and Adjustments* described earlier in this manual.
7. Check operation of airflow sensing switches.
8. Check for water leaks on the boiler or water pooling around boiler.
9. Manually operate the relief valve. If the water is grey or black, there is excessive oxygen in the system. Oxygen is corrosive to boilers. Eliminate any source of oxygen.
10. Verify proper operation after servicing.



AM-1

TROUBLESHOOTING

When a problem occurs with the boiler operation, the IQ Control System easily provides specific, valuable information to help resolve the issue quickly. The display on the IQ Boiler control should be the first place to check.

If "Err" IS NOT displayed on the IQ Boiler Control: Use the following table to determine the problem and possible causes.

IQ Boiler Control Status Codes (when "Err" is not displayed)			
Display		Status	Boiler / Control Action(s)
Blank		Boiler and Circulator off	No 120 Vac power at boiler, check breaker and wiring between breaker panel and boiler.
StA	1	Boiler not responding to Heat Request	Boiler is not seeing Heat Request. Check thermostat or zone wiring for loose connection, miswiring, or defective thermostat or zone control.
StA	2	Waiting for Pressure Switch to Open	The blower is "off" and the control waits for the pressure switch to open. This state checks if the pressure switch has failed closed. This is checked at the beginning of a heat cycle before turning on the blower. If the pressure switch doesn't open in 60 seconds, the control goes to StA 12.
StA	3	Waiting for Pressure Switch to Close	The blower is turned "on". The control is waiting for the pressure switch to close at the beginning of a cycle. If the pressure switch doesn't close within 60 seconds, the control goes to StA 11.
StA	8	Boiler Running but Circulator is not Running	Check wiring for loose connection, miswiring. When there is a Domestic Hot Water Heat Request wired to the Outdoor Air Reset card the Circulator will be off for the duration of the priority time. This to allow all of the boiler output to be provided for fast Indirect Water Heater recovery. Check Priority Time (Pt_) function using Outdoor Air Reset IQ Option Card Adjustment Mode (see Reset Card Adjustment Mode instructions).
StA	10	Retry Delay	The burner failed to light (no flame signal). After a 5 minute delay, IQ Control will attempt to light the burner again. There is no limit to the number of retries.
StA	10	Recycle Delay	The burner loses flame during running mode (StA code "8"). After a 10 second delay, IQ Control will attempt to light the burner again. If the burner loses flame during running mode (StA code "8") during the next six recycles, IQ Control will progress to a soft lockout.
StA	11	Pressure Switch Failed to Open	The blower is still "off", and the pressure switch has not opened at the beginning of the heat cycle. An alarm message is sent but the control is not in lockout.
StA	12	Pressure Switch Failed to Close	The blower is still "on", and the pressure switch has not closed at the beginning of the heat cycle. An alarm message is sent but the control is not in lockout.
StA	13	Soft Lockout	When a soft lockout occurs, boiler will shut down. Boiler automatically restarts once condition that caused the lockout is corrected and the one-hour time delay is completed. Boiler can be restarted sooner than the time delay by using Adjustment Mode function and manually resetting boiler (see Adjustment Mode instructions).
StA	14	Hard Lockout	When a hard lockout occurs boiler shuts down. Boiler will NOT automatically restart once the condition that caused the lockout is corrected. It will be necessary to go to Adjustment Mode function to manually reset the boiler (see Adjustment Mode instructions).
StA	15	Wait for Limit to Close	Heat Request occurs and start of operating sequence is halted due to an open limit. Open limits may include Flame Roll Out Switch or Auxiliary. Limit or Low Water Cutoff IQ Option Cards (when installed), refer to IQ Option Panel display for additional information.
StA	16	Flame Out of Sequence	Flame Signal is still present when expected to be 0 (no flame).

TROUBLESHOOTING (continued)

If "Err" IS displayed on the IQ Boiler Control: "Err" flashes on the IQ Boiler control display followed by a number. Use the following table along with this error number to determine the problem and possible causes:

IQ Boiler Control Error Codes (when "Err" is flashing)			
Display		Status	Boiler / Control Action(s)
Blank		Boiler and Circulator off	No 120 Vac power at boiler, check breaker and wiring between breaker panel and boiler.
Err	2	Pressure Switch Failed to Open	While the blower is "off" the pressure switch failed to open (contacts stuck closed), check wiring and check pressure switch.
Err	4	Flame Current Lower than Threshold	Check pilot assembly.
Err	6	Flame Sensed Out of Normal Sequence	Flame sensed out of normal sequence (before opening gas valve or after closing gas valve).
Err	18	Electronics Failure	Replace Control .
Err	23	Flame Sensed During Pre-Purge	Flame sensed during pre-purge (before gas valve signaled opened).
Err	29	Pressure Switch Failed to Close	While the blower is "on" the pressure switch failed to close, check wiring, check that the blower is running and check pressure switch.
Err	32	Temperature Sensor Failure	Temperature sensor or interface failure (open or short connection, increased connection resistance, dual sensor mismatch) or control hardware failure.
Err	57	Flame Rod Shorted to Burner Ground	Flame Rod shorted to burner ground, this can result from excessive flue gas condensation.
Err	58	AC Line Frequency Error	AC Signal is too noisy or frequency is incorrect.
Err	59	Line Voltage Error	AC voltage out of specification high or low.
Err	60	Thermostat Input Higher than Threshold	Check thermostat wiring.
Err	61	Line Voltage Unstable	Possibly too many heavy loads switching on and off cause erratic supply voltage.
Err	63	Soft Lockout - Maximum Recycles Exceeded	Maximum number of recycles exceeded. For additional information refer to SLR 10 on previous page.
Err	64	Soft Lockout - Internal Failure	Caused by general electronics failure such as relay open or shorted contacts, flame sensing circuit error, or A to D error.

TROUBLESHOOTING (continued)

If IQ Boiler Control Shows Status Code "StA 15": The IQ Boiler Control is "Waiting for Limit to Close" and the display on the IQ Option Panel should be the first place to check. The IQ Option Panel display (lower display) will show one of the following status codes:

IQ Option Panel Display Shows "Err"			
Display		Status	Boiler / Control Action(s)
Err	1	Low Input Voltage	AC voltage is too low
Err	2 - card #	IQ Option Card Type Change without Re-Learn	Whenever a new IQ Option Card is first installed into the IQ Option Panel, the IQ Option Panel automatically "Learns" the card. This means it detects the specific card and lists it as a card number (C1, C2, or C3). However, to help avoid errors or unauthorized option card changes, once an IQ Option Card is initially installed, the IQ Option Panel will not automatically "Learn" a different card in the same slot. In this situation, the IQ Option Panel has to "Learn" about the new card manually. To have the IQ Option Panel recognize or "Learn" about a different card, the user must press the "I" key on the IQ Option Panel until "Lrn" is displayed. Then press and hold either the Up ⇧ or Down ⇩ key for at least three (3) seconds. The IQ Option Panel will then recognize and "Learn" the new IQ Option Card.
Err	3 - card #	IQ Option Card Communications Error	The IQ Option Card is not installed properly or has an internal fault. Remove the card and check for bent IQ Option Panel card interface pins. Straighten bent or misaligned pins or choose another card slot and reinstall card. If problem persists, replace card.
Err	4 - card #	IQ Option Card Hardware Interface Error	The IQ Option Card is not installed properly, there is a option card or IQ Option Panel fault. Remove the card and check for bent IQ Option Panel card interface pins. Straighten bent or misaligned pins or choose another card slot and reinstall card. If problem persists, replace card.
Err	5	Limit Output OFF in ON State	Check limit string wiring, replace the IQ Option Panel.
Err	6	Incorrect Wiring	Check boiler wiring.
Err	7	Internal IQ Option Panel Error	Replace the IQ Option Panel.
Err	8	Limit Output ON in OFF State	Check limit string wiring, replace the IQ Option Panel.
Err	9	Hard lockout due to repeated Err 8	Check limit string wiring, replace the IQ Option Panel.

If IQ Option Panel Display Shows "OL": The OL- "card number" indicates the card slot causing the Open Limit. For example, "OL-C1" means open limit in the card located in card slot 1. To determine the cause of the open limit the user must switch the display on the IQ Option Panel to show the view mode of the IQ Option Card installed in Slot 1.

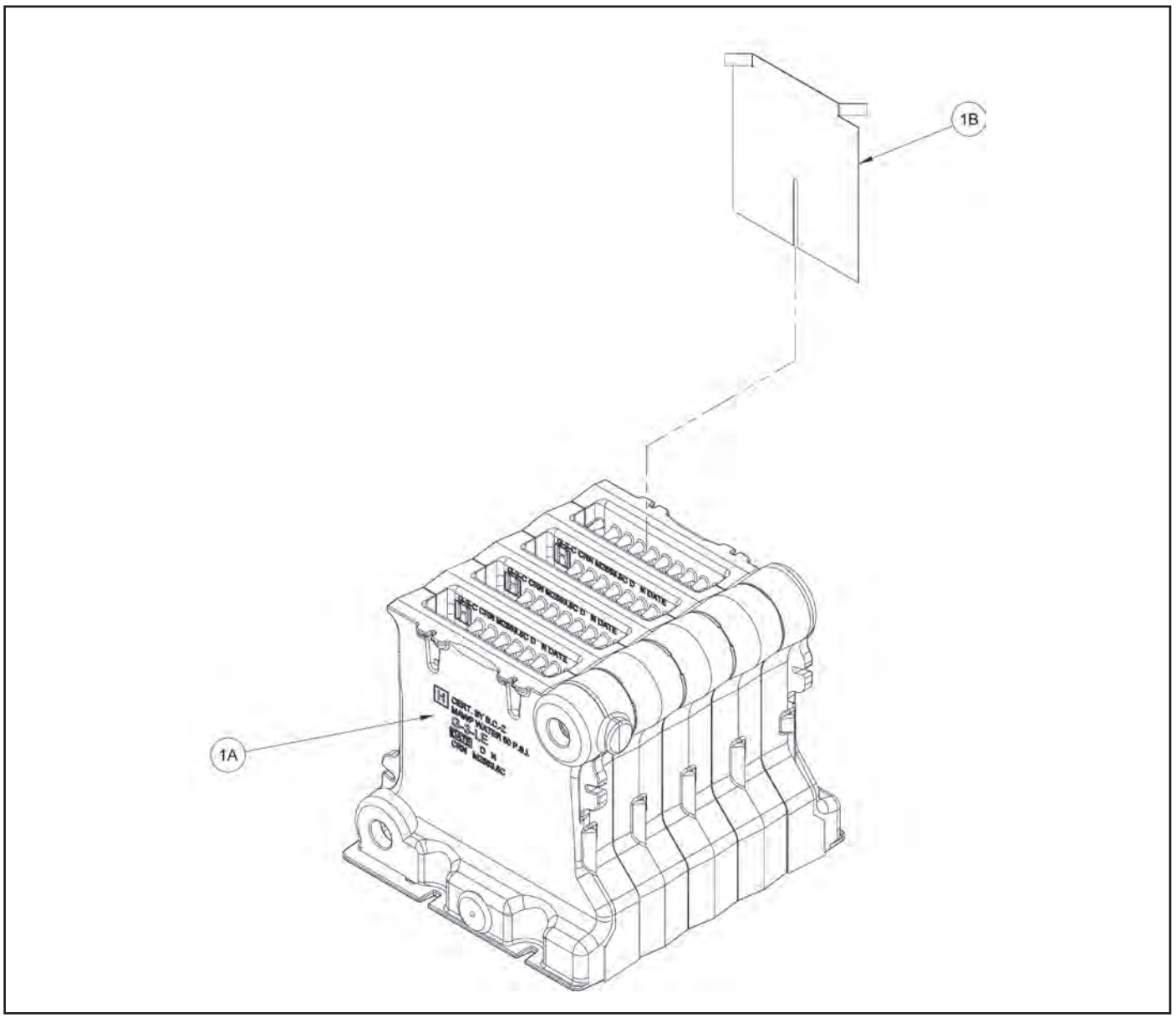
For example, if, while the boiler has a Heat Request, and the Aquastat IQ Option Card installed in Slot 1 has a sensor failure the IQ Option Panel displays OL-C1 (Open Limit Card Slot 1). To investigate the status of option card C1:

1. Press the "I" key on the IQ Option Panel. The display will go from "OL-C1" to C1.
2. When the display shows C1, press either the Up ⇧ or Down ⇩ keys to switch the display to show the view mode of the Aquastat Limit Control IQ Option Card inserted in Slot 1. The display will now read Err 19, Sensor Failure.
3. Check the sensor connections and when required replace the sensor.
4. When the sensor failure is corrected the IQ Option Panel will return to the "O.C.P" display and the IQ Boiler Control start sequence will continue.

For additional information refer to the instruction manual supplied with the IQ Option Card.

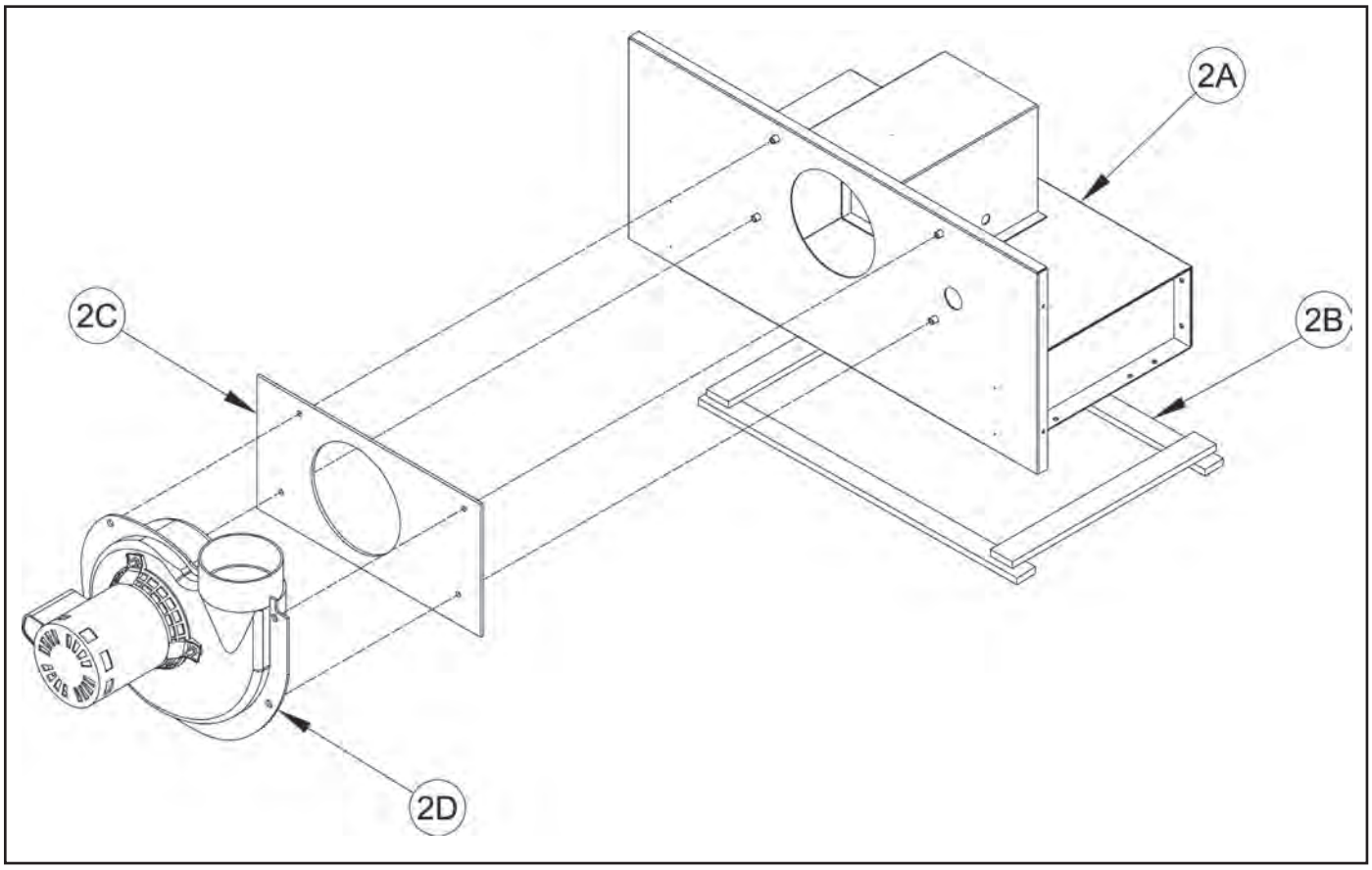
If IQ Option Panel Display Shows "O.C.P": The Option Panel is in normal run or operating mode, the IQ Option Panel display will show "O.C.P" (Option Card Panel) along with a floating decimal point that flashes on and off (the "heartbeat" flash indicating the panel is functioning properly and there are no open limits or errors). The Option Panel or the card installed in the option panel are not causing the open limit.

1. Check for loose boiler wiring and check flame roll out & blocked vent switches.



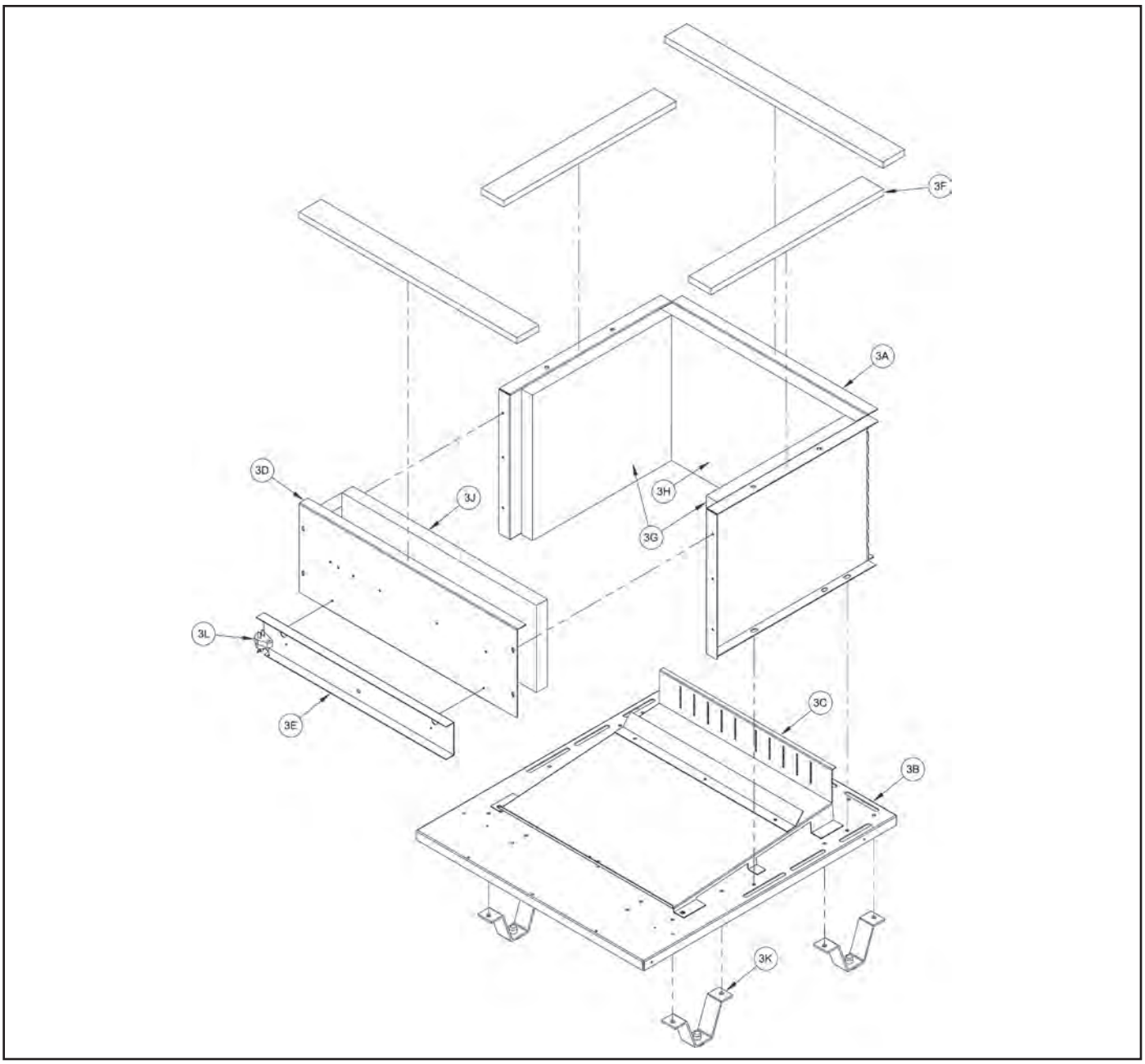
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
1A	Block Assembly	102287-03	102287-04	102287-05	102287-06	102287-07	102287-08	102287-09
1B	Flue Baffle	[2] 71107002	[3] 71107002	[4] 71107002	[5] 71107002	[6] 71107002	[7] 71107002	[8] 71107002

REPAIR PARTS (continued)



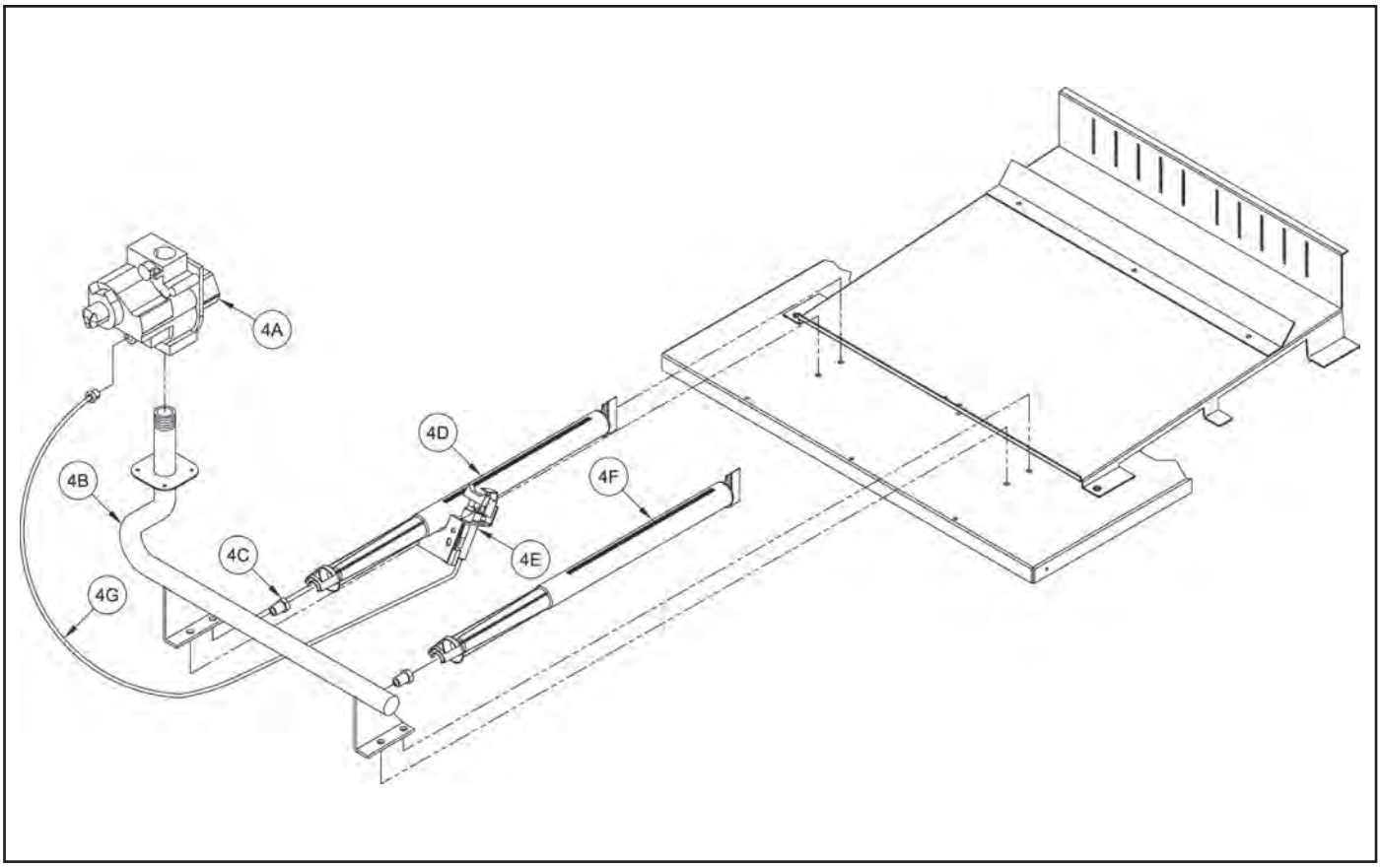
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
2A	Canopy Assembly - Sea Level	102594-03	102594-04	102594-05	102594-06	102594-07	102594-08	102594-09
	Canopy Assembly - High Altitude	102594-13	102594-14	102594-15	102594-16	102594-17	102594-18	102594-19
2B	Canopy Gasket Kit	6206001						
2C	Fan Gasket	8206085						
2D	Fan	81161512						

REPAIR PARTS (continued)



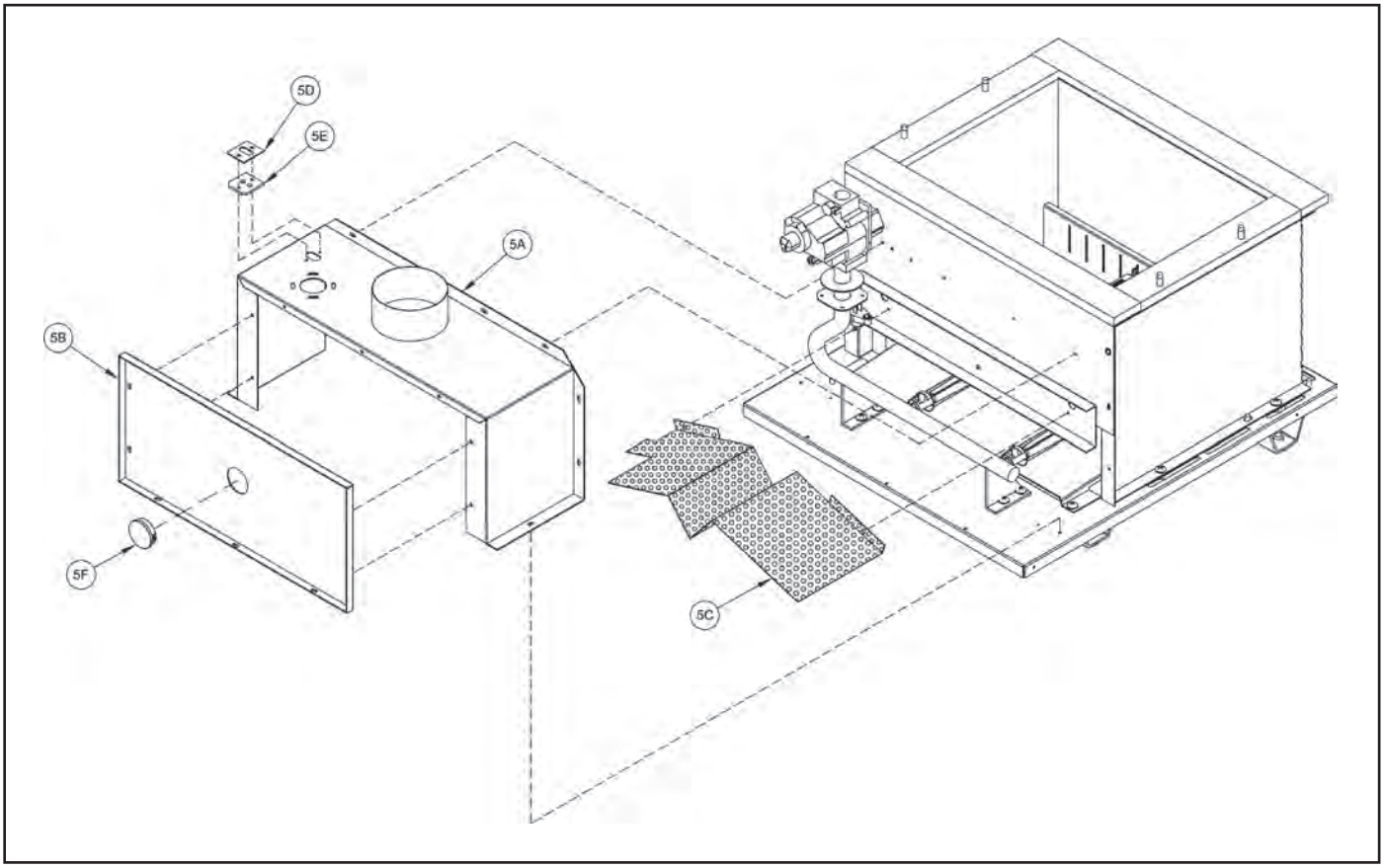
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
3A	Base Wrapper	71807031	71807041	71807051	71807061	71807071	71807081	71807091
3B	Base Tray	102543-03	102543-04	102543-05	102543-06	102543-07	102543-08	102543-09
3C	Burner Tray Assembly	61807031	61807041	61807051	61807061	61807071	61807081	61807091
3D	Base Front Panel	102705-03	102705-04	102705-05	102705-06	102705-07	102705-08	102705-09
3E	Burner Access Panel	102707-03	102707-04	102707-05	102707-06	102707-07	102707-08	102707-09
3F	Base Gasket Kit	6206002						
3G	Base Side Insulation	[2] 72007001						
3H	Base Rear Insulation	72007031	72007041	72007051	72007061	72007071	72007081	72007091
3J	Base Front Insulation	72007032	72007042	72007052	72007062	72007072	72007082	72007092
3K	Base Leg Assembly	[4] 6186001						
3L	Flame Roll-out Switch	80160044						

REPAIR PARTS (continued)



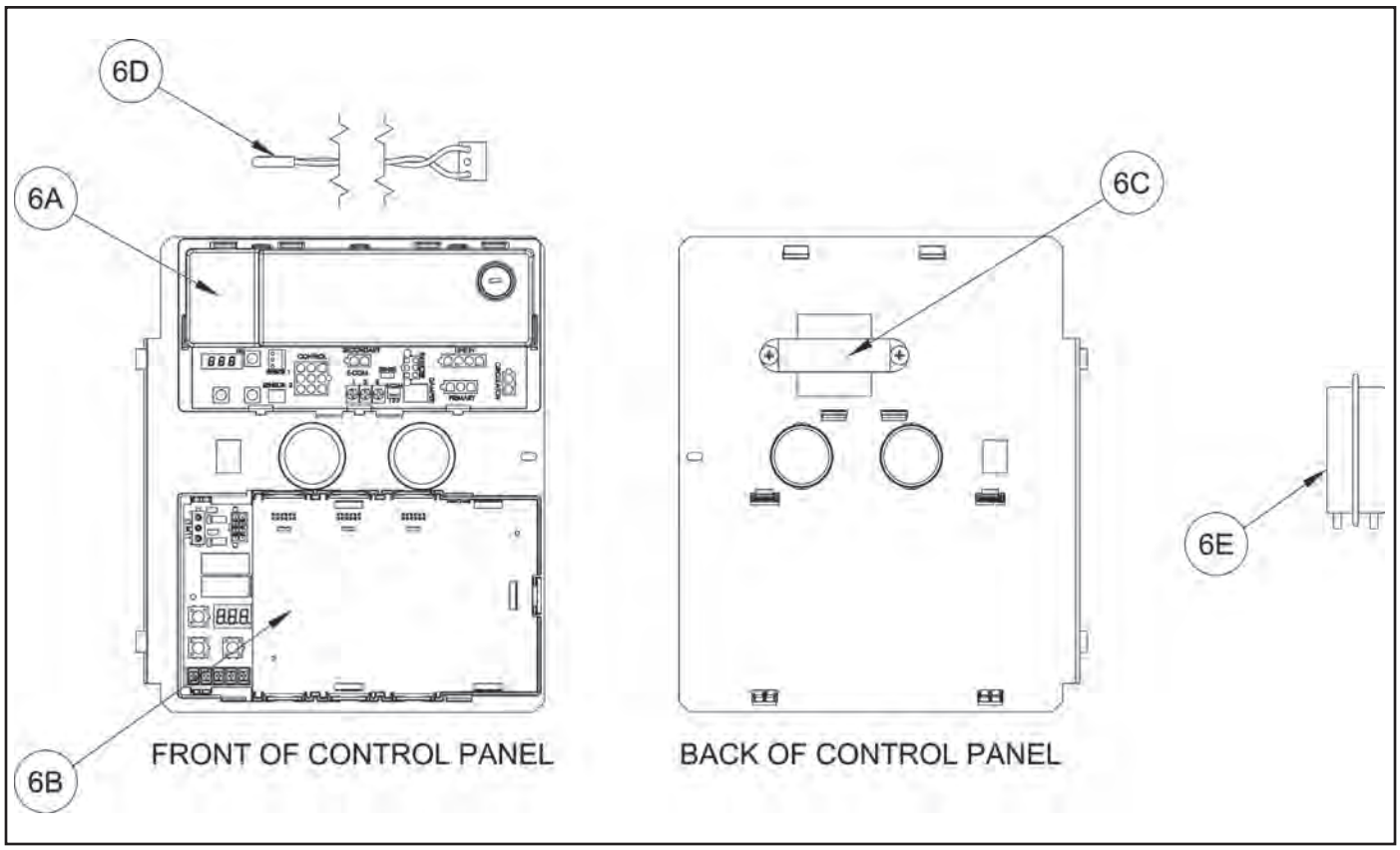
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
4A	Gas Valve (Natural Gas), Honeywell VR8204P1171	81660282				N/A		
	Gas Valve (Natural Gas), Honeywell VR8304P4496	N/A				81660283		
	Gas Valve (LP Gas), Honeywell VR8204C3015	81660146				N/A		
	Gas Valve (LP Gas), Honeywell VR8304P4280	N/A				81660181		
4B	½" Gas Manifold	82207031	82207041	82207051	82207061	---	---	---
	¾" Gas Manifold	---	---	---	---	82207071	82207081	82207091
4C	Burner Orifices - Natural Gas #47	[4] 822710	[6] 822710	[8] 822710	[10] 822710	[12] 822710	[14] 822710	[16] 822710
	Burner Orifices - LP Gas 120mm	[4] 822792	[6] 822792	[8] 822792	[10] 822792	[12] 822792	[14] 822792	[16] 822792
4D	Pilot Burner	100147-01						
4E	Pilot Assembly - Natural Gas	102592-01						
	Pilot Assembly - LP Gas	102593-01						
4F	Main Burner	[3] 100146-01	[5] 100146-01	[7] 100146-01	[9] 100146-01	[11] 100146-01	[13] 100146-01	[15] 100146-01
4G	Pilot Tubing	8236122						

REPAIR PARTS (continued)



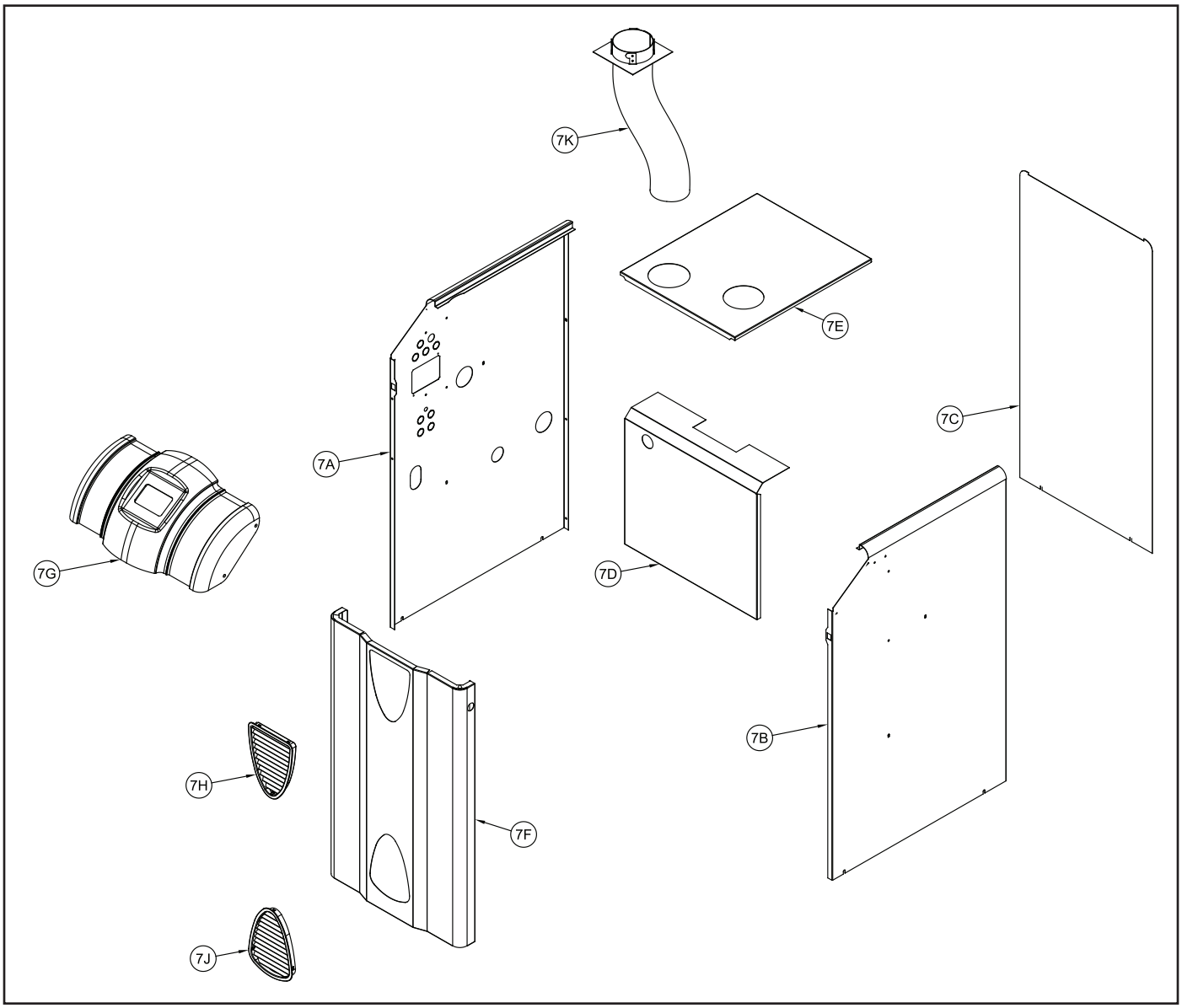
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
5A	Air Box Assembly	61807032	61807042	61807052	61807062	61807072	61807082	61807092
5B	Air Box Door	71807034	71807044	71807054	71807064	71807074	71807084	71807094
5C	Combustion air diffuser	N/A	71807049	71807059	71807069	71807079	71807089	71807099
5D	Pilot Tube Gasket Cover Plate	7096002						
5E	Pilot Tube Gasket	8206038						
5F	Window Plug	102202-01						

REPAIR PARTS (continued)



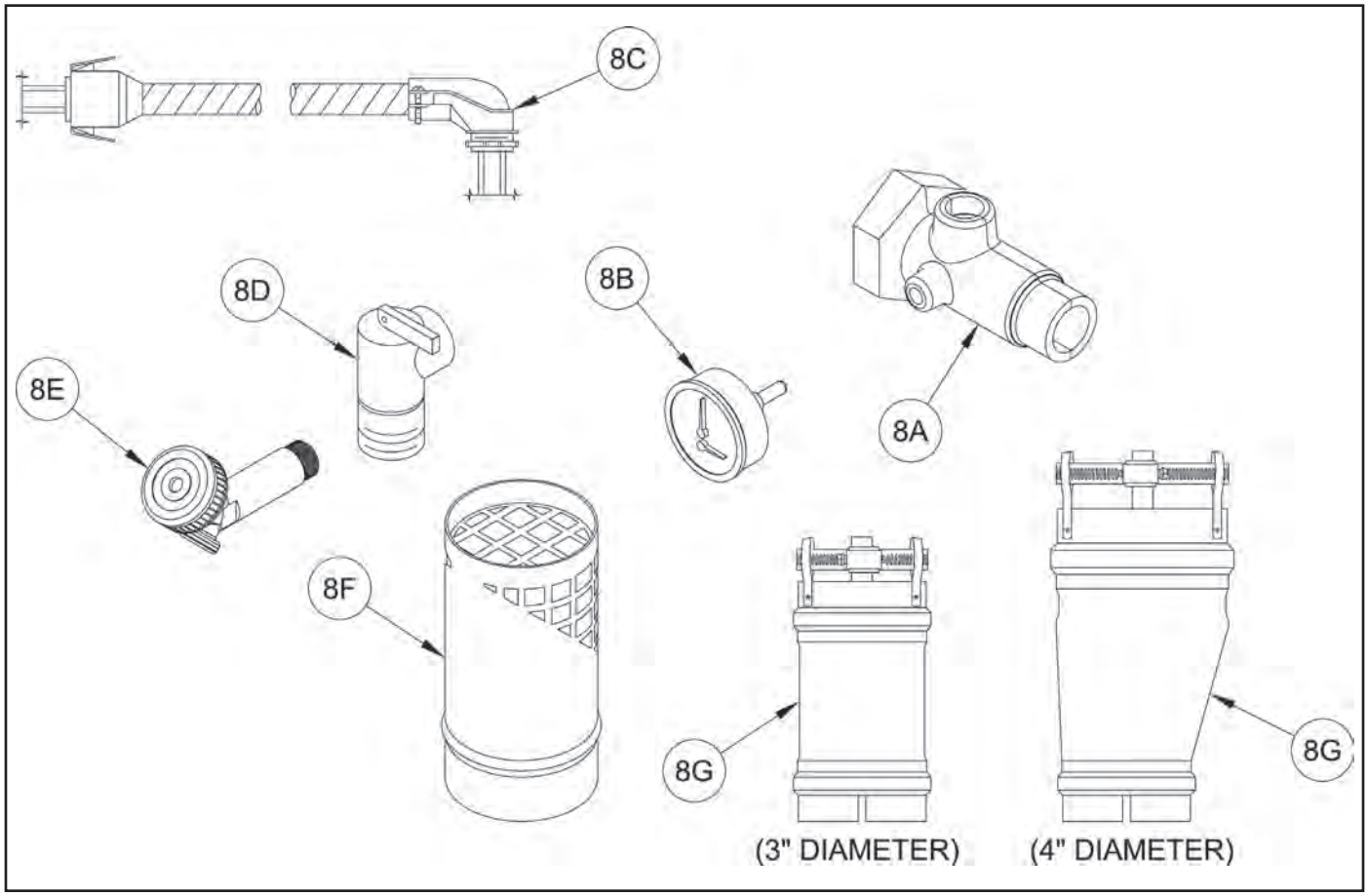
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
6A	IQ Boiler Control	102290-01						
6B	IQ Option Panel	102291-01						
6C	Transformer	102516-01						
6D	Temperature Sensor	102411-01						
6E	Differential Pressure Switch Sea Level 0' - 4999'	80160762	80160761		80160760	80160759	80160760	
	High Altitude - 5000' - 10,000'	80160759	80160763		80160764	80160765	80160764	

REPAIR PARTS (continued)



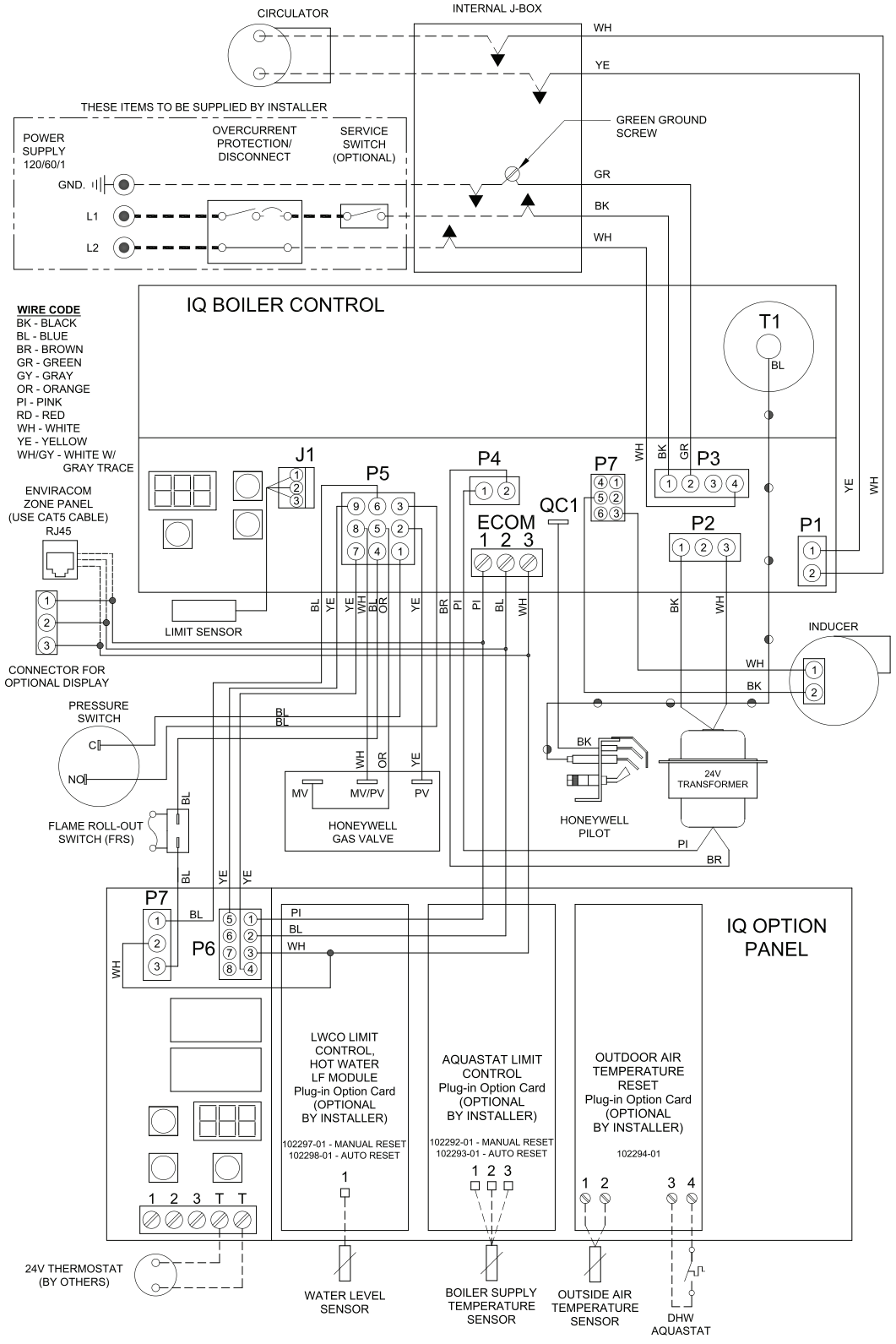
Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
7A	Jacket Left Side Panel	102566-01						
7B	Jacket Right Side Panel	102567-01						
7C	Jacket Rear Panel	102587-03	102587-04	102587-05	102587-06	102587-07	102587-08	102587-09
7D	Jacket Vestibule Panel	102588-03	102588-04	102588-05	102588-06	102588-07	102588-08	102588-09
7E	Jacket Top Panel	102586-03	102586-04	102586-05	102586-06	102586-07	102586-08	102586-09
7F	Jacket Front Door	102661-03	102661-04	102661-05	102661-06	102661-07	102661-08	102661-09
7G	Jacket Poly Front Cover	102600-03	102600-04	102600-05	102600-06	102600-07	102600-08	102600-09
7H	Upper Poly Grille	102621-01						
7J	Lower Poly Grille	102622-01						
7K	Air Intake Collar Assembly	60407003		60407004		60407005		

REPAIR PARTS (continued)



Key No.	Description	[Quantity] Part Number						
		ESC3	ESC4	ESC5	ESC6	ESC7	ESC8	ESC9
8A	Water Manifold	80607001						
8B	Temperature/Pressure Gauge	100282-01						
8C	Circulator Wiring Harness	6130701						
8D	Safety Relief Valve	81660363						
8E	Drain Valve	102802-01						
8F	Vent Terminal	8110701					8110702	
8G	Air Intake Terminal (Not Shown)	6116045		6116044		6116063		
8H	Vent Connector	8110703					8110704	

INTERNAL WIRING



WIRE TYPE LEGEND

- LOW VOLTAGE FACTORY WIRING SIZE 20 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
- LOW VOLTAGE FACTORY WIRING SIZE 22 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
- LOW VOLTAGE FIELD WIRING
- LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE FIELD WIRING
- IGNITOR - 250°C
- GROUND - SIZE 18 AWG TYPE SF-2, STRANDED WIRE, 1/32" INSULATION, 200°C
- LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE CL2(X) OR CL3R STRANDED WIRE, 75 TO 105°C

NOTES:

1. IF ANY OF THE ORIGINAL WIRE SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACES WITH THE SAME TYPE SHOWN OR ITS EQUIVALENT. S'IL FAUT REMPLACER UN FIL QUELCONQUE D'ORIGINE FOURNI AVEC L'APPAREIL, UTILISER OBLIGATOIREMENT UN FIL DE MÊME TYPE DONNÉ OU SON ÉQUIVALENT.

Figure IW-1: Wiring Diagram

INTERNAL WIRING (continued)

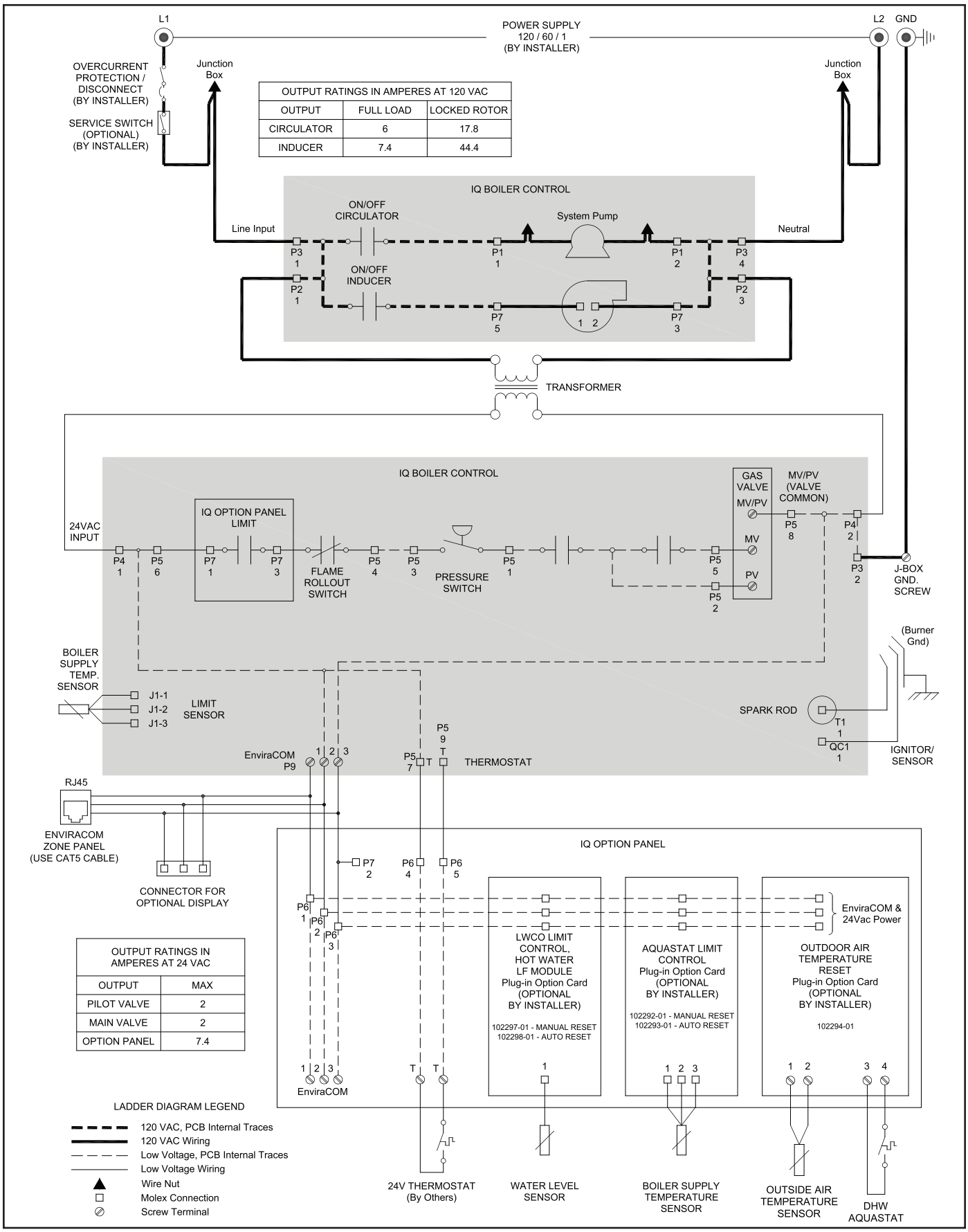


Figure IW-2: Wiring Diagram

INTERNAL WIRING (continued)

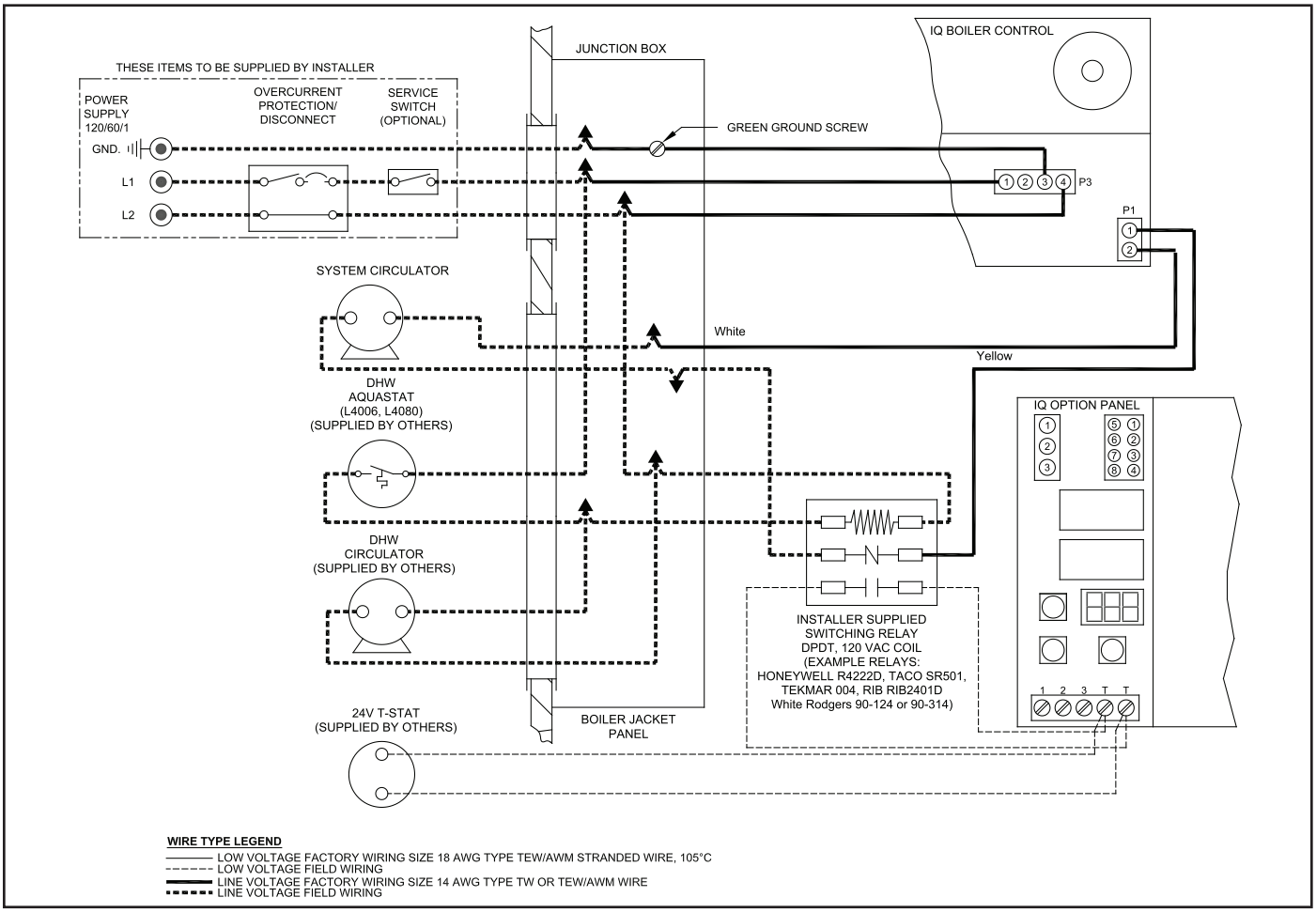

IQ BOILER CONTROL
JUNCTION BOX
THESE ITEMS TO BE SUPPLIED BY INSTALLER
POWER SUPPLY 120/60/1
OVERCURRENT PROTECTION/ DISCONNECT
SERVICE SWITCH (OPTIONAL)
GND.
L1
L2
GREEN GROUND SCREW
P3
P1
SYSTEM CIRCULATOR
White
Yellow
DHW AQUASTAT (L4006, L4080) (SUPPLIED BY OTHERS)
IQ OPTION PANEL
DHW CIRCULATOR (SUPPLIED BY OTHERS)
INSTALLER SUPPLIED SWITCHING RELAY DPDT, 120 VAC COIL (EXAMPLE RELAYS: HONEYWELL R4222D, TACO SR501, TEKMAR 004, RIB RIB2401D White Rodgers 90-124 or 90-314)
1 2 3 T T
24V T-STAT (SUPPLIED BY OTHERS)
BOILER JACKET PANEL
WIRE TYPE LEGEND
LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
LOW VOLTAGE FIELD WIRING
LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
LINE VOLTAGE FIELD WIRING

Figure IW-3: Single Zone System with Domestic Hot Water Tank

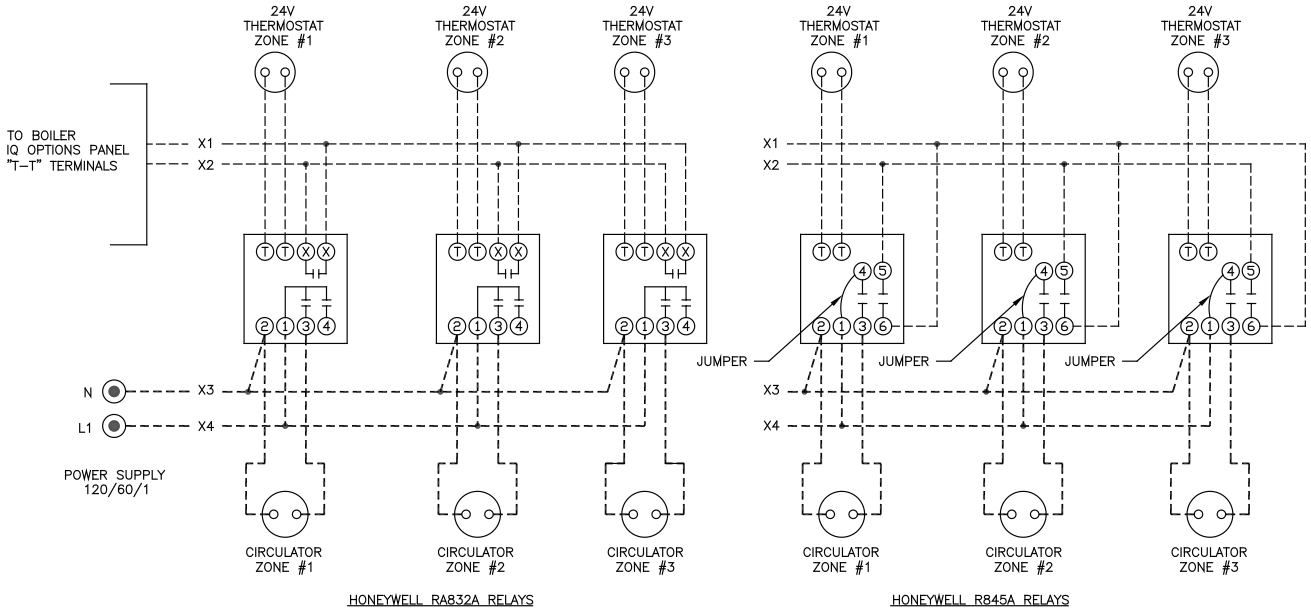


Figure IW-4: Multiple Zone System with Zone Circulators

INTERNAL WIRING (continued)

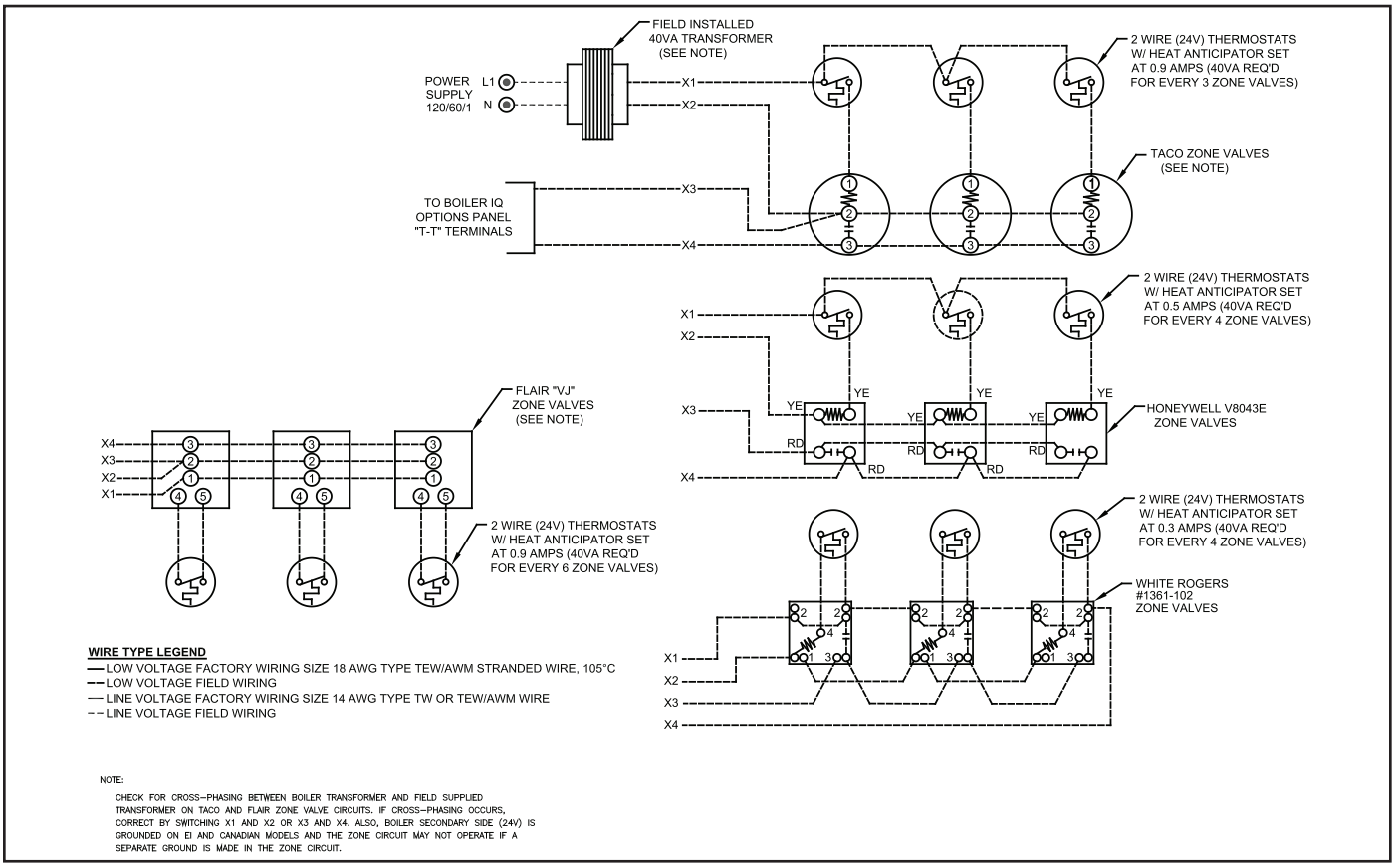

FIELD INSTALLED
40VA TRANSFORMER
(SEE NOTE)
POWER SUPPLY 120/60/1
L1
N
X1
X2
X3
X4
TO BOILER IQ OPTIONS PANEL "T-T" TERMINALS
2 WIRE (24V) THERMOSTATS W/ HEAT ANTICIPATOR SET AT 0.9 AMPS (40VA REQ'D FOR EVERY 3 ZONE VALVES)
TACO ZONE VALVES
(SEE NOTE)
2 WIRE (24V) THERMOSTATS W/ HEAT ANTICIPATOR SET AT 0.5 AMPS (40VA REQ'D FOR EVERY 4 ZONE VALVES)
YE
RD
HONEYWELL V8043E ZONE VALVES
FLAIR "VJ" ZONE VALVES
(SEE NOTE)
2 WIRE (24V) THERMOSTATS W/ HEAT ANTICIPATOR SET AT 0.9 AMPS (40VA REQ'D FOR EVERY 6 ZONE VALVES)
2 WIRE (24V) THERMOSTATS W/ HEAT ANTICIPATOR SET AT 0.3 AMPS (40VA REQ'D FOR EVERY 4 ZONE VALVES)
WHITE ROGERS #1361-102 ZONE VALVES
WIRE TYPE LEGEND
LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
LOW VOLTAGE FIELD WIRING
LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
LINE VOLTAGE FIELD WIRING
NOTE:
CHECK FOR CROSS–PHASING BETWEEN BOILER TRANSFORMER AND FIELD SUPPLIED TRANSFORMER ON TACO AND FLAIR ZONE VALVE CIRCUITS. IF CROSS–PHASING OCCURS, CORRECT BY SWITCHING X1 AND X2 OR X3 AND X4. ALSO, BOILER SECONDARY SIDE (24V) IS GROUNDED ON EI AND CANADIAN MODELS AND THE ZONE CIRCUIT MAY NOT OPERATE IF A SEPARATE GROUND IS MADE IN THE ZONE CIRCUIT.

Figure IW-5: Multiple Zone System with Zone Valves

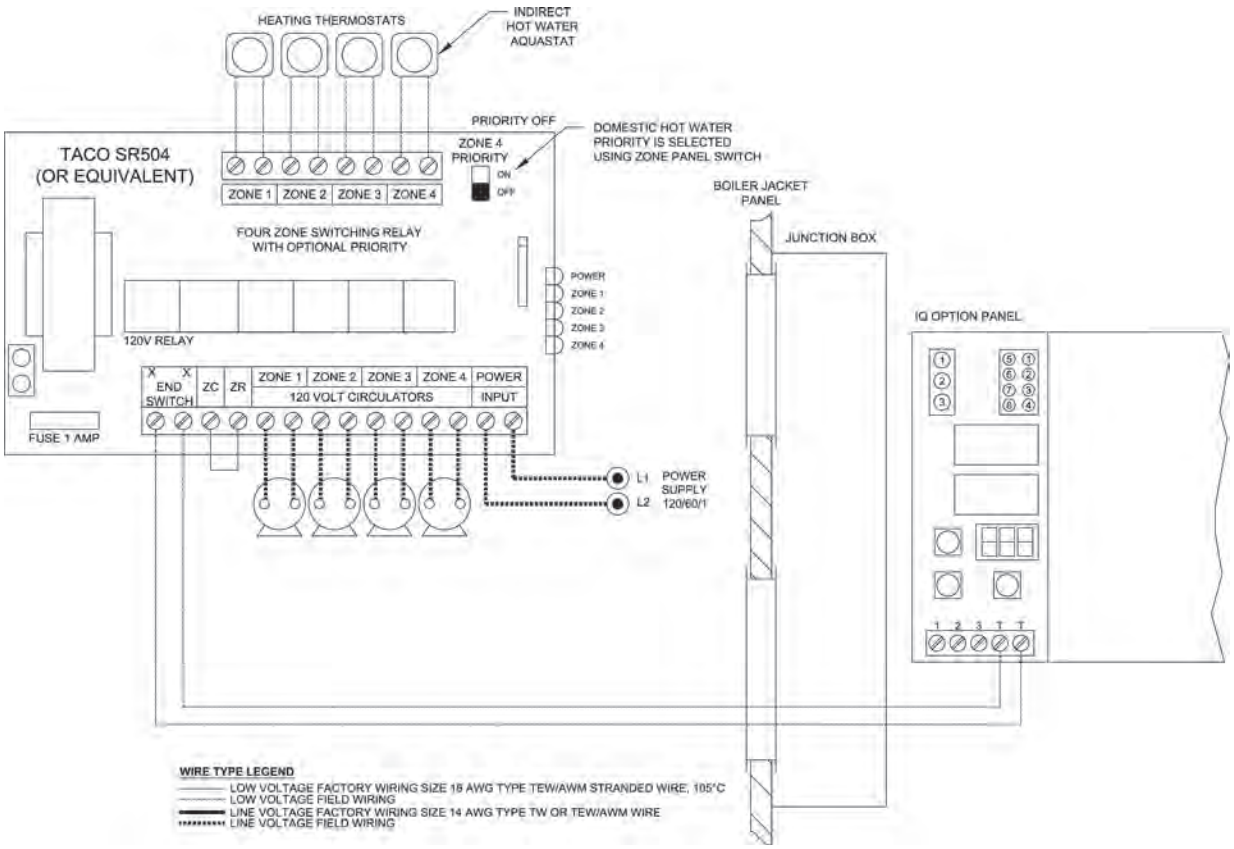


Figure IW-6: Multiple Zone System with Zone Circulator Panel

INTERNAL WIRING (continued)

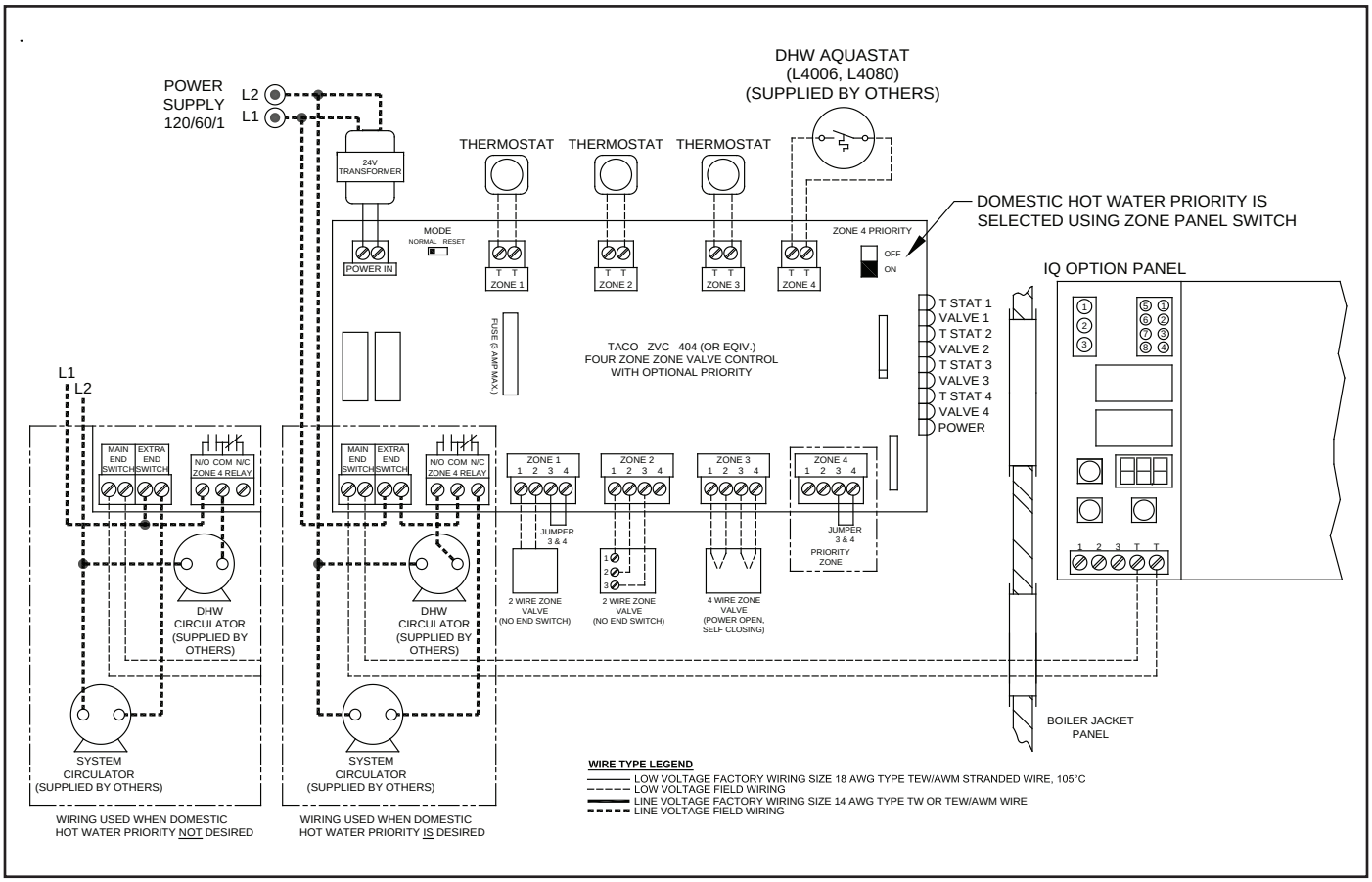


Figure IW-7: Multiple Zone System with Zone Valve Panel

APPENDIX A – COMBUSTION AIR

⚠ PROVIDE ENOUGH AIR to ventilate the boiler room, dilute the flue gases, and sustain combustion. Ignition failure, overheating, fire, carbon monoxide, and spillage of flue gases may result from poor air supply.

If the boiler is a Direct Vent boiler and exchanges all combustion air and combustion products directly with the outdoors, there are no special requirements for providing combustion, ventilation, and dilution air.

If the boiler is chimney vented, power vented or induced draft and draws combustion air from within the building, follow the steps below to determine how to provide air to the boiler.

Is the boiler located in a confined space?:

1. Calculate the floorspace (in square feet) of the boiler room and all rooms connected to the boiler room by passageways not furnished with doors.

   _____ *floorspace (sq. ft.)*

2. Add up the input rates of all the combustion appliances installed in the same floorspace.

   _____ *combined appliance input (BTU/hr)*

3. In the table below, find the Minimum Allowable Floorspace based on the Combined Input Rate from Step 2 and the ceiling height. If the Combined Input Rate is between two rates, use the next highest rate.

   _____ *minimum allowable floorspace (sq. ft.)*

Minimum Allowable Floorspace in the Boiler Room and Freely Connected Rooms (sq. ft.)

		Ceiling Height			
		7’	8’	9’	10’
Combined Appliance Input Rate (see Step 2) (BTU/hr)	50,000	357	313	278	250
	100,000	714	625	556	500
	150,000	1071	938	833	750
	200,000	1429	1250	1111	1000
	250,000	1786	1563	1389	1250
	300,000	2143	1875	1667	1500
	350,000	2500	2188	1944	1750
	400,000	2857	2500	2222	2000

4. If the Floorspace from Step 1 is *less than* the Minimum Floorspace from Step 3, then you must provide outdoor air to the boiler room. Proceed to Step 6.

Is the boiler located in a building of unusually tight construction?

5. If the answer to *all* of the three questions below is “yes”, then you must provide outdoor air to the boiler room.

   Do the walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder with a rating of 1 perm or less, with openings gasket or sealed?

   ❑ *Yes* ❑ *No*

   Are operable windows and doors weatherstripped?

   ❑ *Yes* ❑ *No*

   Are exterior wall joints caulked or sealed?

   ❑ *Yes* ❑ *No*

6. If you must provide outdoor air to the boiler room, the top of the permanent opening into the boiler room must be within 12” of the ceiling, and the free area of the opening (sq. in.) must be no less than the Combined Appliance Input (from Step 2) divided by 3000 BTU/hr/sq. in.

   _____ *combined appliance input (Step 2)*

   ÷ 3000 *BTU/hr/sq. in.*

   ____ *Minimum Opening Size (sq. in.)*

7. Duct this opening vertically or horizontally directly to the outdoors, or directly to a space that communicates directly with the outdoors, such as an attic or crawlspace.

For more details and options, refer to your local building code, the *National Fuel Gas Code* (*NFPA 54* and *ANSI Z223*), and the *Canadian Natural Gas Installation Code CAN/CGA-B149.1* or *Propane Installation Code CAN/CGA-B149.2.*

APPENDIX B – VENTING

⚠ VENT THIS BOILER according to the instructions. Failure to do so may cause products of combustion to enter the building resulting in severe property damage, personal injury or death.

i *Install this boiler according to this manual and the National Fuel Gas Code, ANSI Z223.1/NFPA 54, the Natural Gas and Propane Installation Code, CAN/CSA B149.1, or applicable provisions of the local building codes. Contact local building or fire officials about restrictions and installation inspection in your area.*

This Appendix consists of two sections (B2, and B3). Refer to the section appropriate for the type of boiler you are installing or servicing.

B2 Direct Vent "Direct vent" is also called "sealed combustion". All combustion air is drawn from outside the building directly into the boiler. The boiler vents vertically or horizontally, assisted by a fan in the boiler. Gas vent must resist temperature and corrosion and be sealed against leakage of flue gases and condensate. Approved materials include AL29-4C stainless steel, polypropylene, CPVC and PVC, depending on the boiler. Combustion air provided by a separate PVC or galvanized steel pipe, or by the combustion air pipe in a concentric polypropylene vent system.

B3 Power Vent Similar to Direct Vent, but some or all combustion air is drawn from inside the building. May draw air directly from the boiler room without the use of a combustion air pipe.

If you are removing an existing boiler from a gas vent or chimney that is also used to vent other gas appliances:

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other deficiencies which could cause an unsafe condition.
3. Resize the common venting system to approach the minimum size as determined using the *National Fuel Gas Code*, ANSI Z223.1 and/or CAN/CSA B149.1, *Installation Codes*.
4. Check the draft of each remaining appliance using the procedure described in Appendix G, checking draft and combustion.
5. Correct any draft problems before placing the gas appliances back into service.

i *In addition to previously mentioned vent codes of the main general guidelines, atmospheric vented installations must also be in accordance with the Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, ANSI/NFPA 211. For Canada installations, refer to the National Gas and LP Installation Code, CAN/CSA B149.1.*

APPENDIX B1 INTENTIONALLY OMITTED

APPENDIX B2 – DIRECT VENTING

GENERAL WARNINGS FOR DIRECT VENT SYSTEMS

DRAFTHOODS, VENT DAMPERS and other obstructions or openings in the vent system are prohibited.

DO NOT REDUCE THE DIAMETER of the vent pipe.

MOISTURE AND ICE may collect around and below the vent terminal. Keep the area in good repair.

IF USING A CHIMNEY AS A CHASE for the vent, do not vent any other appliance into the space between the chimney wall and the vent.

ELIMINATE LOW SPOTS in the vent where flue gas condensate may pool.

DO NOT PENETRATE VENT PIPE with holes or fasteners.

Planning a Direct Vent System

1. Avoid contact with plumbing or electrical wires.
2. Horizontal vent pipe must maintain a minimum ¼ inch per foot slope down towards boiler.
3. Any condensate forming in the vent will return to the boiler. Provide for a condensate trap or siphon near the boiler to remove condensate from the vent.
4. Support the piping to maintain vent location and prevent sag. The vent and/or air intake piping must be adequately supported with straps or supports with a maximum spacing of five (5) feet on horizontal runs.
5. Adhere to the boiler's maximum and minimum allowable vent lengths. Vent length is provided in terms of *equivalent length* of straight pipe plus equivalent length of fittings, including both the vent and the combustion air piping, but not including vent or intake terminals.
6. Maintain minimum allowable clearances between the vent pipe and combustible materials as specified by the vent pipe supplier, this manual, and applicable building codes.
7. Do not install venting system components on the exterior of the building except as specifically required by these instructions.
8. Locate the vent terminal per these restrictions and Figure B-2:
   (1) Minimum twelve (12) inches above grade plus normally expected snow accumulation level, or seven (7) feet above grade, if located adjacent to public walkway. Do not install over public walkway where local experience indicates appliance flue gas vapor or condensate creates a nuisance or hazard.
   (2) Minimum three (3) feet above any forced draft combustion air intake located within ten (10) feet.
   (3) Minimum four (4) feet horizontally from unsheltered electric meters, gas meters (six (6) feet Canadian Installations), gas regulators, and gas relief valves.
   (4) Minimum twelve (12) inches from overhangs or corners of buildings.
   (5) If window and/or air inlet is within four (4) feet of an inside corner, then vent terminal must be at least six (6) feet from adjoining wall of inside corner.
   (6) Minimum one (1) foot below, one (1) foot horizontally from, or one (1) foot above any door, window, or gravity air inlet.

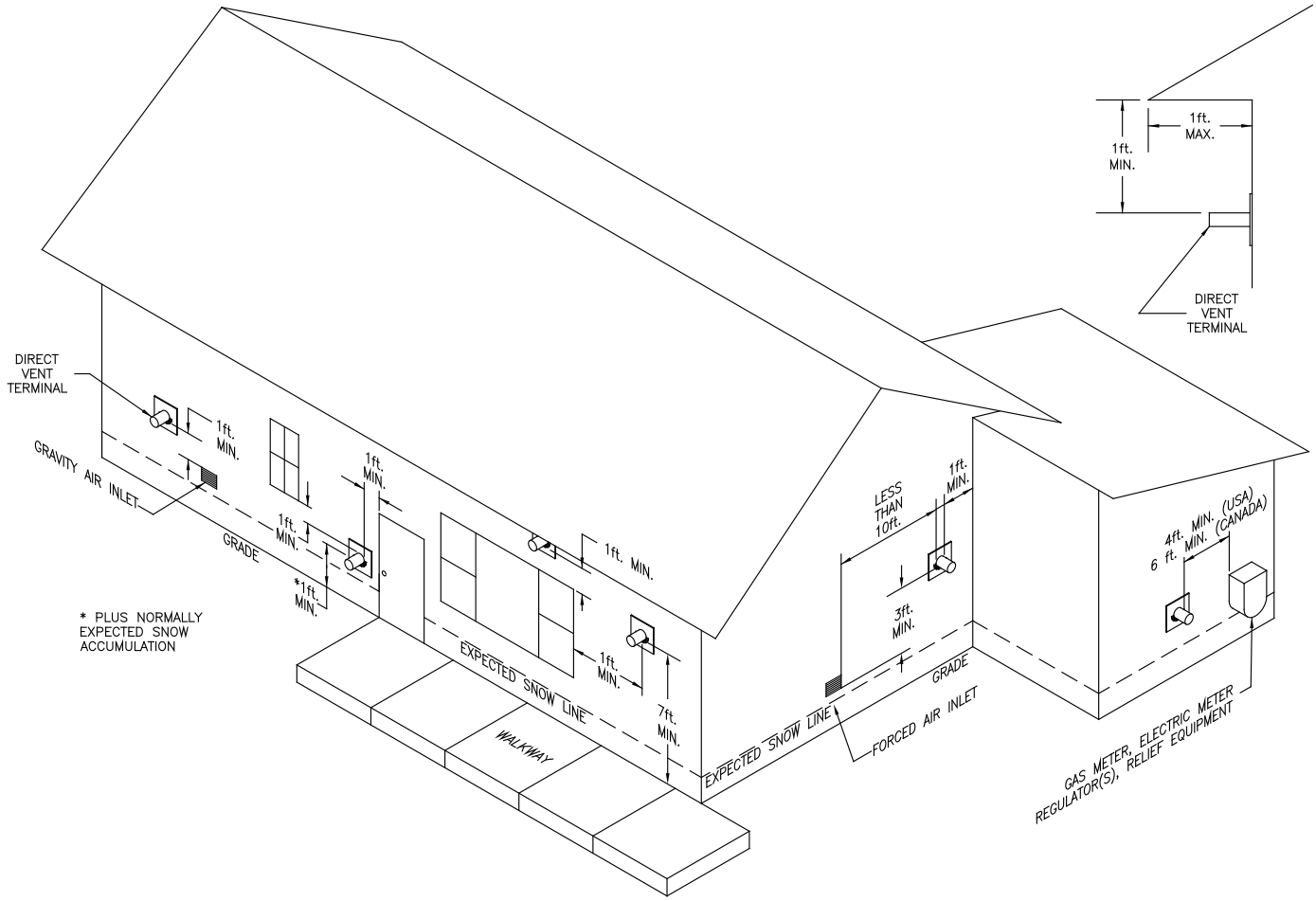


Figure B-2: Approved Terminal Locations

9. Locate the combustion air terminal on the same face of the building as the vent termination to prevent nuisance boiler shutdowns.

10. If the vent passes through interior spaces in floors above the boiler room, enclose the vent with material having a fire resistance rating at least equal to the rating of the adjoining floor or ceiling. Maintain minimum clearances to combustible materials between the enclosure and the vent.

11. Use appropriate designed thimbles when passing through combustible walls (thimble use is optional for noncombustible walls). Ensure thimble is sealed to prevent moisture from entering structure.

Planning Vertical Installations –

1. Install fire stop where vent and air intake passes through floors, ceilings or framed walls. The fire stop must close the opening between the vent and/or air intake pipe and the structure.

2. Size roof opening to allow easy insertion of vent and air intake piping to allow proper installation of flashing and storm collar to prevent moisture from entering the structure

3. Use appropriately designed vent flashing when passing through roofs. Follow flashing manufacturers' instructions for procedures.

4. Ensure there is a weather-tight seal between the vent and/or air intake piping were it penetrates the storm collar and roof flashing.

5. Extend the vent and air intake pipe to maintain a minimum vertical and horizontal distance of twelve (12) inches from the roof surface. Allow additional vertical distance for expected snow accumulation. Brace as required.

APPENDIX B2 – Direct Venting (continued)

Special Instructions for Stainless Steel Direct Vent

USE STAINLESS STEEL VENTING only with boilers approved for use with stainless steel venting as noted in the *Specifications* Section of this manual.

AL 29-4C® stainless steel vent systems resist the corrosive effects of high temperature acidic flue gas condensate and are leak-tight. Alternate stainless steel venting systems require special adaptors to connect to the parts supplied with the boiler. Obtain the adaptors from the supplier of the alternate manufacturer's venting system. Approved alternate brands are:

(1) *Heat-fab Inc – Saf-T- Vent*
800-772-0739

(2) *Flex –L International Inc*. *– Star 34*
800- 561-1980

(3) *Z-Flex U.S. Inc. – Z-Vent*
800-654-5600

(4) *Protech Systems, Inc. – FasNSeal*
800-766-3473

Installing Stainless Steel Vent

1. Follow all general warnings and instructions for Direct Vent systems described in the opening section of *Appendix B2 Direct Venting*. Start at the vent connector on the boiler and work towards the vent terminal.
2. Select stainless steel vent components from Table B-1.
3. Verify that the vent and air intake components do not exceed the boiler's maximum allowable equivalent venting length, and do not fall below the boiler's minimum equivalent venting length, using the worksheet on the following page.
4. If a non-standard length is required, there are two options:

   (1) Select adjustable length pipe from Table B-1. The pipe adjusts 7" from 12 ¾" to 19 ¾". Or,

   (2) Cut the non-gasketed end of a standard straight length. Make a square cut and file the end smooth.

Table B-1: Vent System and Air Intake System Components

Vent System Component	Part Number
3" Dia. Pipe x 1 Ft	8116296U
4" Dia. Pipe x 1 Ft	100176-01
3" Dia. Pipe x 3 Ft	8116298U
4" Dia. Pipe x 3 Ft	100177-01
3" Dia. Pipe x 5 Ft	8116300U
4" Dia. Pipe x 5 Ft	100178-01
3" Dia. Pipe x Adjustable	8116319U
4" Dia. Pipe x Adjustable	100179-01
3" Dia. 90° Elbow	8116294U
4" Dia. 90° Elbow	100180-01
3" Dia. 45° Elbow	8116292U
4" Dia. 45° Elbow	100181-01
3" Dia. Horizontal Drain Tee	8116302U
4" Dia. Horizontal Drain Tee	100182-01
3" Dia. Vertical Drain Tee	8116304U
4" Dia. Vertical Drain Tee	100183-01
3" Single Wall Thimble	8116116
4" Single Wall Thimble	100184-01
3" Double Wall Thimble	8116115
4" Double Wall Thimble	100185-01

5. Remove dirt and grease from the male end of the joint using an alcohol pad.
6. Align weld seams in pipes and use a slight twisting motion to fully insert the male end into the female end of the joint.

   DO NOT DISLODGE, SCRATCH, OR CUT THE FACTORY GASKET.

7. Tighten locking band by hand with a 5/16" nut driver, plus ¼" turn past snug, ensuring that the locking band fully captures the bead in the pipe.

Horizontal Stainless Steel Vent Installations

1. Install vent and intake piping per Figure B-3.
2. Where the vent pipe penetrates any combustible wall (Figure B-4):

APPENDIX B2 – Direct Venting (continued)

Special Instructions for Stainless Steel Direct Vent (continued)

Vent/Combustion Air, Equivalent Length Work Sheet

This sheet is supplied to assist in vent/combustion air, equivalent length calculating

Combustion Air (PVC shown)				Vent (stainless special gas vent)			
90° elbow(s) PVC				90° elbow(s)			
Quantity =		x 5' =	equiv. ft. a.	Quantity =		x 5' =	equiv. ft. a.
45° elbow(s) PVC				45° elbow(s)			
Quantity =		x 2.5' =	equiv. ft. b.	Quantity =		x 5' =	equiv. ft. b
Straight pipe PVC				Straight pipe			
Length ft. =		x 1 =	equiv. ft. c.	Length ft. =		x 1 =	equiv. ft. c.
				Horizontal drain tee			
				Length ft. =		x 2' =	equiv. ft. d.
				Vertical drain tee			
				Length ft. =		x 7' =	equiv. ft. e.
Total*		a.+b.+c. =	equiv. ft.	Total*		a.+b.+c.+d.+e.=	equiv. ft.

* Total cannot exceed 60 equiv. ft. length.

Vent and combustion air terminals do not count towards total equiv. ft.

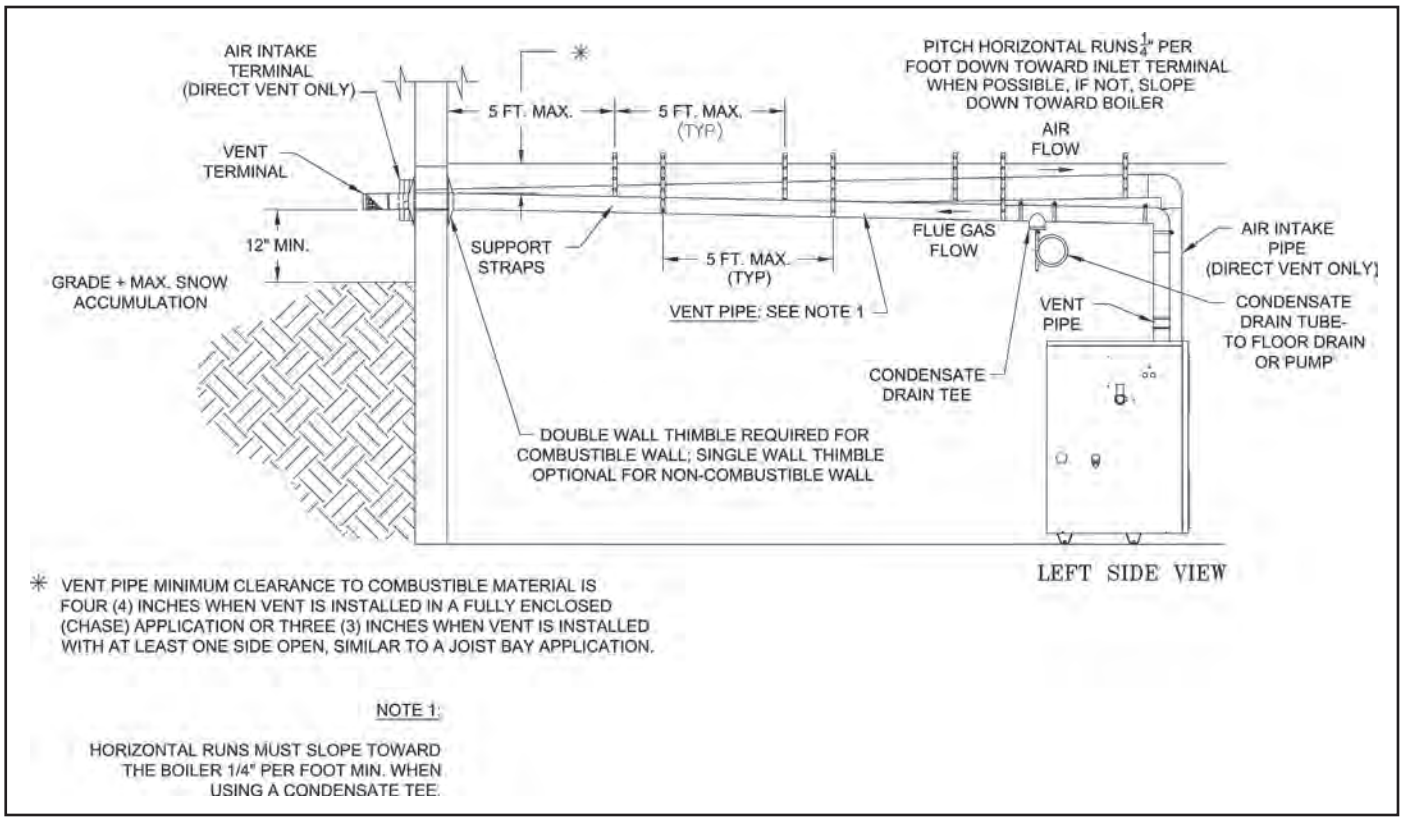

AIR INTAKE TERMINAL (DIRECT VENT ONLY)
VENT TERMINAL
12" MIN.
GRADE + MAX. SNOW ACCUMULATION
5 FT. MAX.
5 FT. MAX. (TYP)
SUPPORT STRAPS
5 FT. MAX. (TYP)
VENT PIPE: SEE NOTE 1
DOUBLE WALL THIMBLE REQUIRED FOR COMBUSTIBLE WALL; SINGLE WALL THIMBLE OPTIONAL FOR NON-COMBUSTIBLE WALL
PITCH HORIZONTAL RUNS 1/4" PER FOOT DOWN TOWARD INLET TERMINAL WHEN POSSIBLE, IF NOT, SLOPE DOWN TOWARD BOILER
AIR FLOW
FLUE GAS FLOW
CONDENSATE DRAIN TEE
VENT PIPE
AIR INTAKE PIPE (DIRECT VENT ONLY)
CONDENSATE DRAIN TUBE- TO FLOOR DRAIN OR PUMP
LEFT SIDE VIEW
✳ VENT PIPE MINIMUM CLEARANCE TO COMBUSTIBLE MATERIAL IS FOUR (4) INCHES WHEN VENT IS INSTALLED IN A FULLY ENCLOSED (CHASE) APPLICATION OR THREE (3) INCHES WHEN VENT IS INSTALLED WITH AT LEAST ONE SIDE OPEN, SIMILAR TO A JOIST BAY APPLICATION.
NOTE 1:
HORIZONTAL RUNS MUST SLOPE TOWARD THE BOILER 1/4" PER FOOT MIN. WHEN USING A CONDENSATE TEE.

Figure B-3: Alternate Separate Horizontal – Vent/Air Intake Installation

APPENDIX B2 – Direct Venting (continued)

Special Instructions for Stainless Steel Direct Vent (continued)

(1) Insert the wall thimble from the outside of the wall, and secure the outside flange to the wall using nails or screws.

(2) Seal any exterior openings in the wall thimble, or between the thimble and the wall, using a weatherproof sealant.

(3) Install the inside thimble flange and secure the flange to the inside wall using screws or nails.

3. Maintain 12" separation between vent and intake terminals. Where the intake air pipe penetrates the external wall, seal the opening with weatherproof sealant (Figure B-4).

4. To install a vertical “snorkel” exterior to the building, refer to Figure B-5 or B-6.

5. An optional concentric adapter kit (P/N 61106012) is available for 3” & 4” stainless steel vents to provide a single exterior wall penetration accommodating both the intake and exhaust. Refer to the installation instructions provided with the concentric adapter.

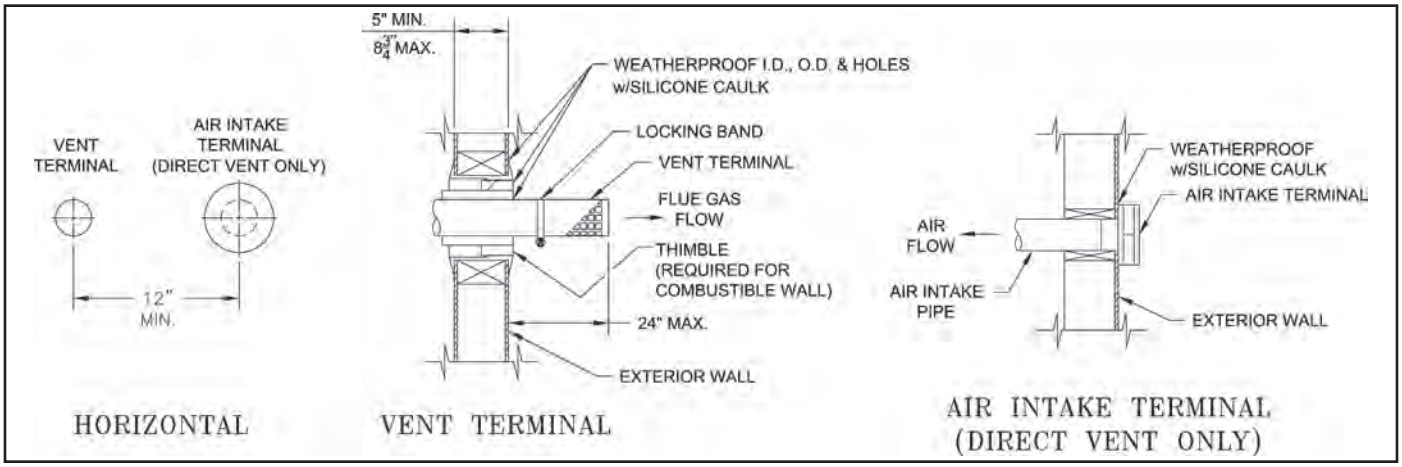


Figure B-4: Separate Horizontal Air Intake Terminal Installation

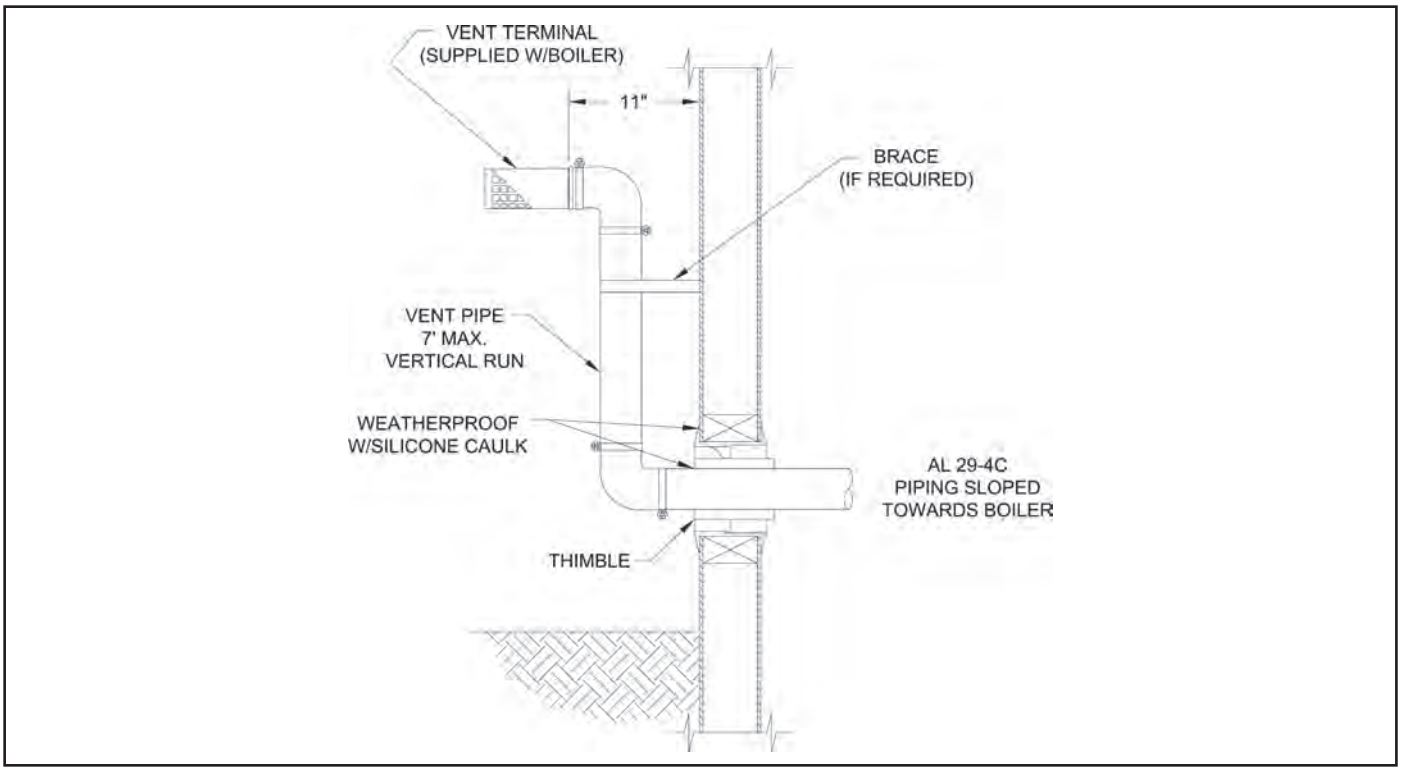


Figure B-5: Optional Separate Horizontal Vent Terminal Installation

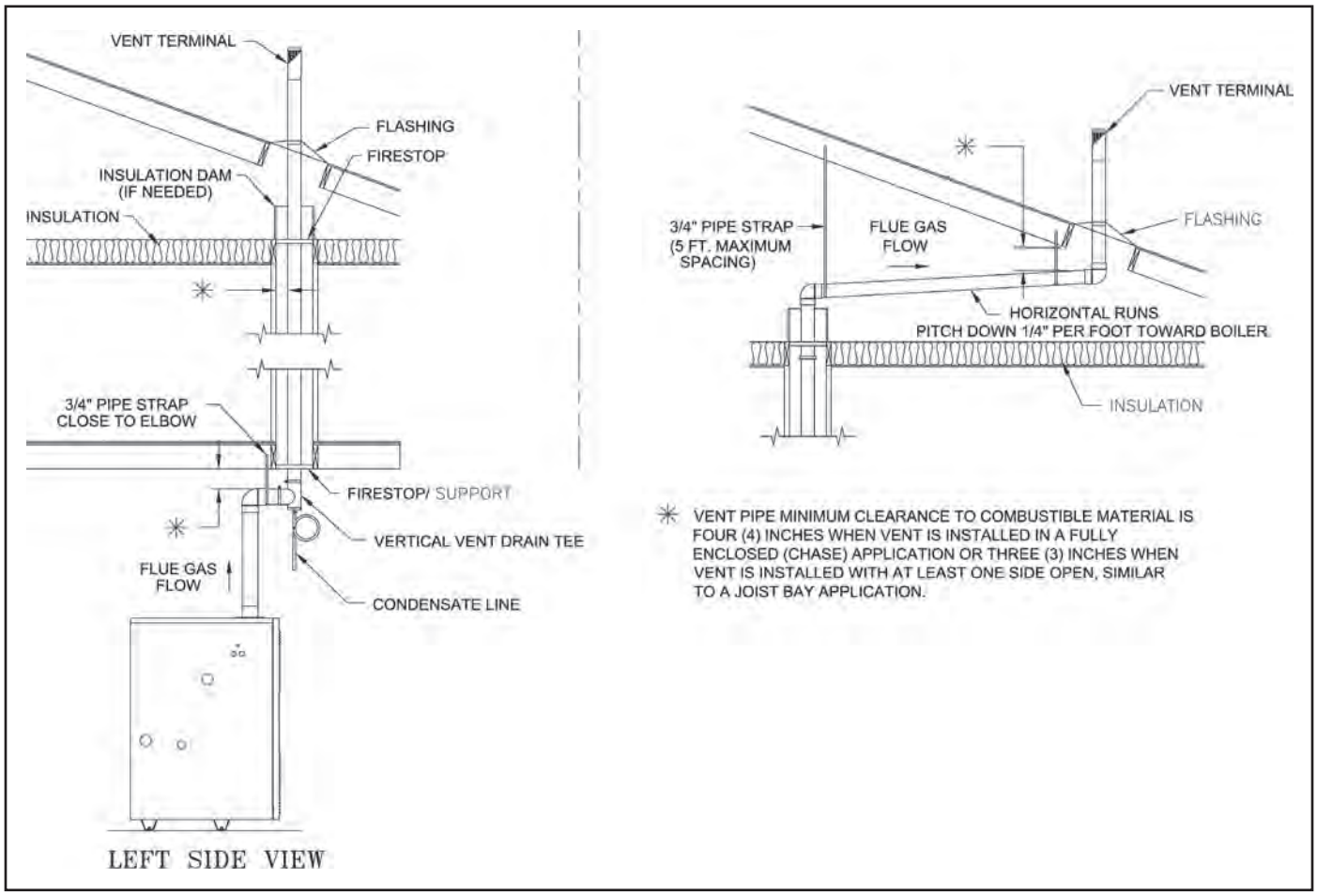


Figure B-6: Typical Vertical Stainless Steel Venting

6. Install the intake air terminal supplied with the boiler onto the outdoor end of the air intake pipe per the instructions in *Connect Venting* in this manual.
7. Install the vent terminal supplied with the boiler onto the outdoor end of the vent pipe per the boiler-specific instructions in *Connect Venting* in this manual.

Vertical Stainless Steel Vent Installation

Storm collar, flashing and sealant for roof penetration, and vertical vent tee for collection of condensate are required for vertical venting and are not supplied with the boiler.

1. Install vent and intake piping per Figures B-6 thru B-8.
2. Install the storm collar onto the vent pipe immediately above the flashing.
3. Apply Dow Corning Silastic 732 RTV Sealant between the vent pipe and the storm collar to provide a watertight and heat-resistant seal.
4. Install the vent terminal per the boiler-specific instructions in *Connect Venting* in this manual.
5. Install the air intake terminal per the boiler-specific instructions in *Connect Venting* in this manual.
6. An optional concentric adapter kit (P/N 100222-01 (3”) and 100223-01 (4”) is available to accommodate both intake and exhaust piping in a single roof penetration. This kit is compatible only with Saf-T Vent SC gas vent produced by Heat-Fab. Refer to the installation instructions included with the kit.

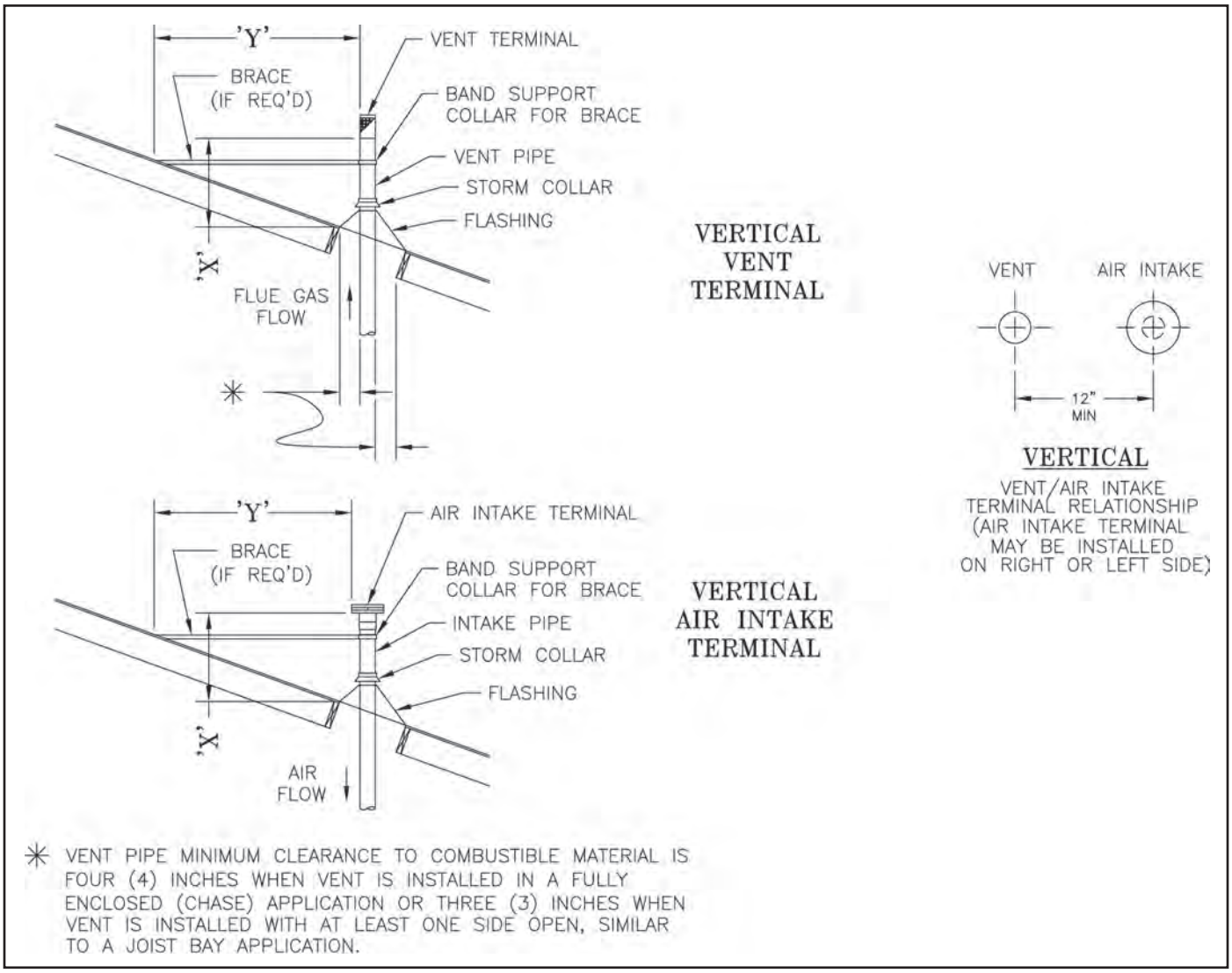


Figure B-7: Vertical Vent/Air Termination Details for Stainless Steel Direct Vent

Extend Vent/Air Intake Piping to maintain minimum vertical (“X”) and minimum horizontal (“Y”) distance of twelve (12) inches from roof surface. Allow additional vertical (“X”) distance for expected snow accumulation.

APPENDIX B2 – Direct Venting (continued)

Special Instructions for Stainless Steel Direct Vent (continued)

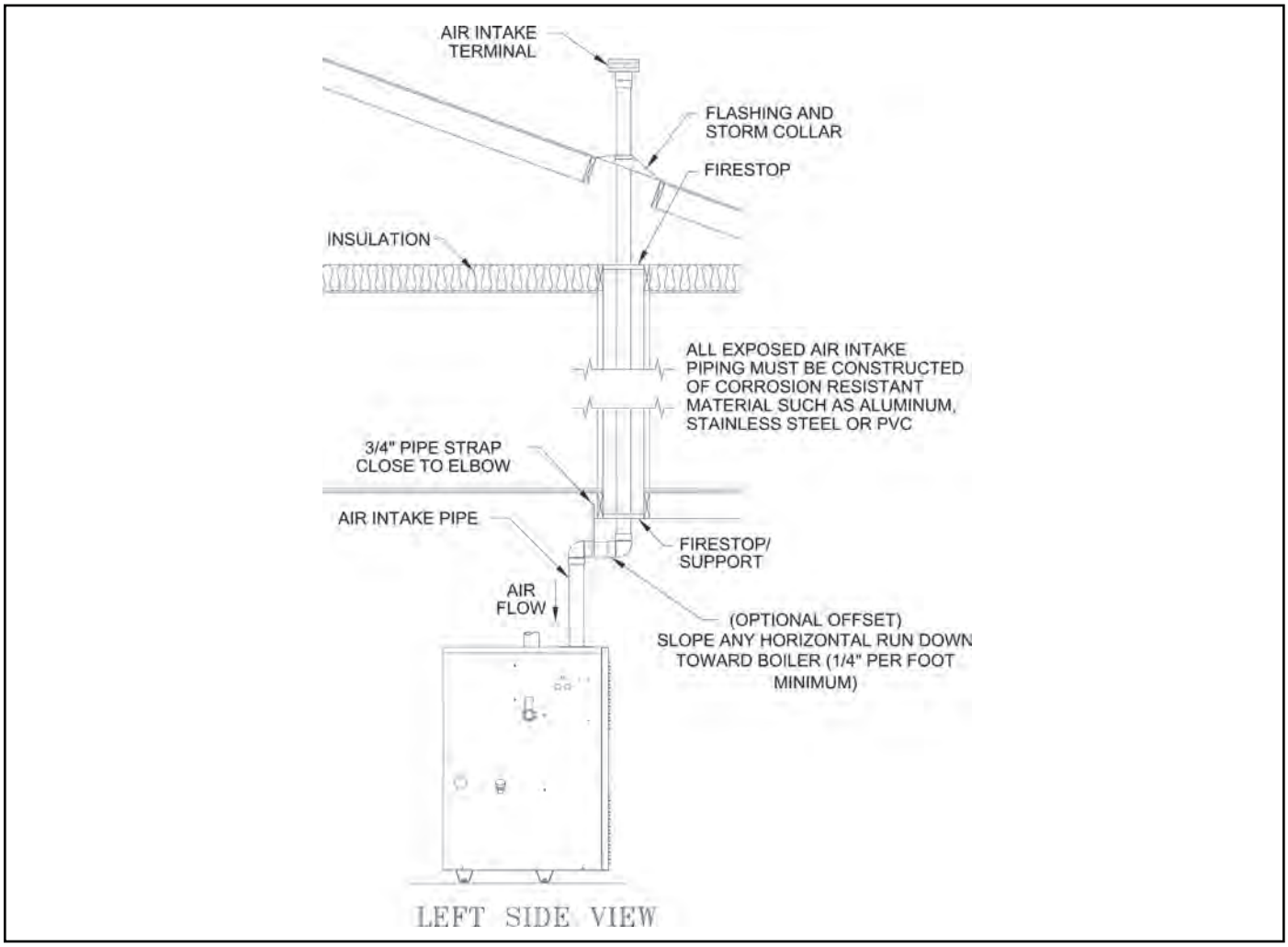

AIR INTAKE TERMINAL
FLASHING AND STORM COLLAR
FIRESTOP
INSULATION
ALL EXPOSED AIR INTAKE PIPING MUST BE CONSTRUCTED OF CORROSION RESISTANT MATERIAL SUCH AS ALUMINUM, STAINLESS STEEL OR PVC
3/4" PIPE STRAP CLOSE TO ELBOW
AIR INTAKE PIPE
FIRESTOP/ SUPPORT
AIR FLOW
(OPTIONAL OFFSET) SLOPE ANY HORIZONTAL RUN DOWN TOWARD BOILER (1/4" PER FOOT MINIMUM)
LEFT SIDE VIEW

Figure B-8: Vertical Air Intake Piping for Direct Venting

APPENDIX B3 – POWER VENTING

Some direct vent boilers are also approved with use of indoor combustion air. If the boiler you are installing is approved for use with indoor combustion air, install the vent according to the instructions in *Appendix B2 Direct Venting*, but omit the "optional" indoor air piping and components. Specific instructions for configuring the boiler for indoor air appear in the boiler-specific instructions at the front of this manual.

APPENDIX C – GAS PIPING

ASSURE GAS PIPING IS LEAK FREE AND OF PROPER SIZE and type for the connected load.

SHUT OFF MAIN GAS SUPPLY prior to installing or servicing boiler gas piping.

1. Determine the boiler's maximum gas demand and minimum gas supply pressure (printed on the boiler's rating label) and the demand of other gas appliances served by the same gas meter.

2. Ensure that gas piping, fittings, and gas meter capacities can supply the maximum gas demand of all appliances at pressures above their minimum allowable gas pressure. The following tables provide typical capacities of gas pipes and fittings.

Table C-1: Maximum Capacity of Schedule 40 Pipe in Cubic Feet Per Hour (CFH)*

Length (Feet)	0.3" w.c. Pressure Drop				0.5" w.c. Pressure Drop			
	½	¾	1	1¼	½	¾	1	1¼
10	132	278	520	1050	175	360	680	1400
20	92	190	350	730	120	250	465	950
30	73	152	285	590	97	200	375	770
40	63	130	245	500	82	170	320	660
50	56	115	215	440	73	151	285	580
60	50	105	195	400	66	138	260	530
70	46	96	180	370	61	125	240	490
80	43	90	170	350	57	118	220	460
90	40	84	160	320	53	110	205	430
100	38	79	150	305	50	103	195	400

*1 CFH of Natural Gas is approximately equal to 1000 BTU/hr; 1 CFH of LP is approximately equal to 2500 BTU/hr.

Table C-2: Equivalent Lengths (ft) Of Standard Pipe Fittings & Valves

Pipe Size	Gate	Globe	Angle	Swing Check	90° Elbow	45° Elbow	90° 'T', Flow Through Run	90° 'T', Flow Through Branch
½"	0	19	9	4	2	1	1	3
¾"	0	23	12	5	2	1	1	4
1"	1	29	15	7	3	1	2	5
1 ¼"	1	39	20	9	4	2	2	7
1 ½"	1	45	22	11	5	3	3	8

ASSURE GAS PIPING IS LEAK FREE AND OF PROPER SIZE and type for the connected load.

SHUT OFF MAIN GAS SUPPLY prior to installing or servicing boiler gas piping.

1. Determine the boiler's maximum gas demand and minimum gas supply pressure

Table C-3: Specific Gravity Correction Factors For Natural Gas

Specific Gravity	Correction Factor	Specific Gravity	Correction Factor
0.50	1.10	0.85	0.81
0.55	1.04	0.90	0.82
0.60	1.00	1.00	0.78
0.65	0.96	1.10	0.74
0.70	0.93	1.20	0.71
0.75	0.90	1.30	0.68
0.80	0.87	1.40	0.66

(printed on the boiler's rating label) and the demand of other gas appliances served by the same gas meter.

2. Ensure that gas piping, fittings, and gas meter capacities can supply the maximum gas demand of all appliances at pressures above their minimum allowable gas pressure. The following tables provide typical capacities of gas pipes and fittings.

3. Derate the gas flow through pipes by multiplying by a correction factor in Table C-3 based on the specific gravity of the gas.

4. For materials or conditions other than those listed above, refer to the National Fuel Gas Code, NFPA54/ANSI Z223.1, or size the system using standard engineering methods acceptable to authority having jurisdiction.

USE PROPER THREAD COMPONENTS on all gas connectors.

USE THREAD (JOINT) COMPOUNDS (pipe dope) rated for liquefied petroleum gas.

5. Bond all above-ground gas piping to a grounding electrode and ensure the piping is electrically continuous.

DO NOT USE GAS PIPING AS A GROUNDING ELECTRODE. Refer to National Electrical Code, NFPA 70.

6. Install sediment trap, ground-joint union and manual shut-off valve upstream of boiler gas control valve and outside jacket.

7. When the piping is completed, test it for leaks.
   (1) When testing over ½ psig, disconnect the boiler and its individual shut-off valve from the gas supply piping.
   (2) When testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shut-off valve.
   (3) Locate leaks using approved combustible gas detector or nonflammable, non-corrosive leak detection solution.

DO NOT CHECK FOR LEAKS USING OPEN FLAMES such as matches or candles or devices that spark.

8. Repair any detected leaks.

APPENDIX D – SYSTEM PIPING

USE PROPER DESIGN AND INSTALLATION PRACTICES and observe all local codes when installing system piping. Property damage and injury may result from an improperly piped or designed heating system.

Boiler damage caused by flawed system design or operation is excluded from our warranty.

Training and experience is required to design and install a piping system that will protect the boiler and provide many years of comfort to the building occupants. Be sure to protect the boiler from the following problems:

1. Corrosion

(1) Comply with the boiler's specific water quality requirements. See the *Specifications* Section of this manual.

(2) Pressurize the system above the highest net positive suction head (NPSH) required for each circulator and ensure positive pressure at the uppermost point in the system.

(3) Maintain a closed boiler system using heat exchangers to transfer heat to open systems, such as domestic hot water systems.

(4) Purge the system completely of dissolved oxygen by bleeding all radiators and installing a properly installed air scoop or air vent.

(5) Repair leaking pipes, fittings, and vents to minimize the need to add makeup water.

(6) Do not fill the boiler with softened water unless makeup water is extremely hard and it is not possible to eliminate all system leaks. If filling the boiler with softened water, test regularly the water softener regularly to ensure that brine solution is not entering the boiler's water supply.

2. Lime scale

(1) Repair leaking pipes, fittings, and vents to minimize the need to add makeup water.

(2) Comply with the boiler's specific water quality requirements. See the *Specifications* Section of this manual.

(3) Comply with the boiler's specific requirements for minimum water flow through the boiler, installing a system bypass or primary-secondary loop if necessary to maintain flow through the boiler when serving small zones.

3. Overpressure

(1) Install a properly sized expansion tank.

(2) Do not exceed the boiler's specific requirements for maximum allowable working pressure.

(3) Do not plug or block the relief valve.

4. Freezing

(1) Run all portions of the system piping inside a heated space unless the system is properly protected with an inhibited antifreeze solution.

5. Overheating

(1) Comply with the boiler's specific requirement for minimum water flow through the boiler. See the *Specifications* Section of this manual.

(2) Install a low-water cutoff device whenever the boiler is installed above the level of the lowest heat emitter or radiator. Also add a low-water cutoff when required by local code requirements.

6. Thermal shock

(1) Do not over-pump. Adhere to the design flow requirements for each zone.

(2) Install a boiler bypass, system bypass, or primary-secondary loop when needed to avoid returning large volumes of cold water directly to a hot boiler.

APPENDIX D – System Piping (continued)

7. Condensation

(1) Do not over-pump. Adhere to the design flow requirements for each zone.

(2) Adhere to the boiler's specific minimum return water and supply water temperature requirements. Install a boiler bypass, system bypass, or primary-secondary loop when needed to maintain water temperatures and flows within the specified limits.

(3) Do not allow chilled water to enter the boiler during the heating cycle, or heated water to enter chilled water coils during the cooling cycle.

8. Dry Fire

Install a low-water cutoff when the boiler is installed above the level of the lowest radiator and when required by local code.

The following system diagrams are intended to provide a minimum level of guidance for a successful and trouble-free installation of the boiler in common applications. They do not substitute for proper design, evaluation, and installation by a trained and qualified installer using the proper tools, techniques, and design expertise. Not all options are available with every boiler.

Hot Water Boilers, Non-Condensing

		Indirect Tank?	Two or more zones of the same temperature?	Two or more zones of different temperatures?	Two or more boilers?
See Diagram	D-W1				
	D-W2		✓		
	D-W3	Tankless Coil			
	D-W4	✓	✓		
	D-W5	✓	✓	✓	
	D-W6	✓	✓		✓

APPENDIX D – System Piping (continued)

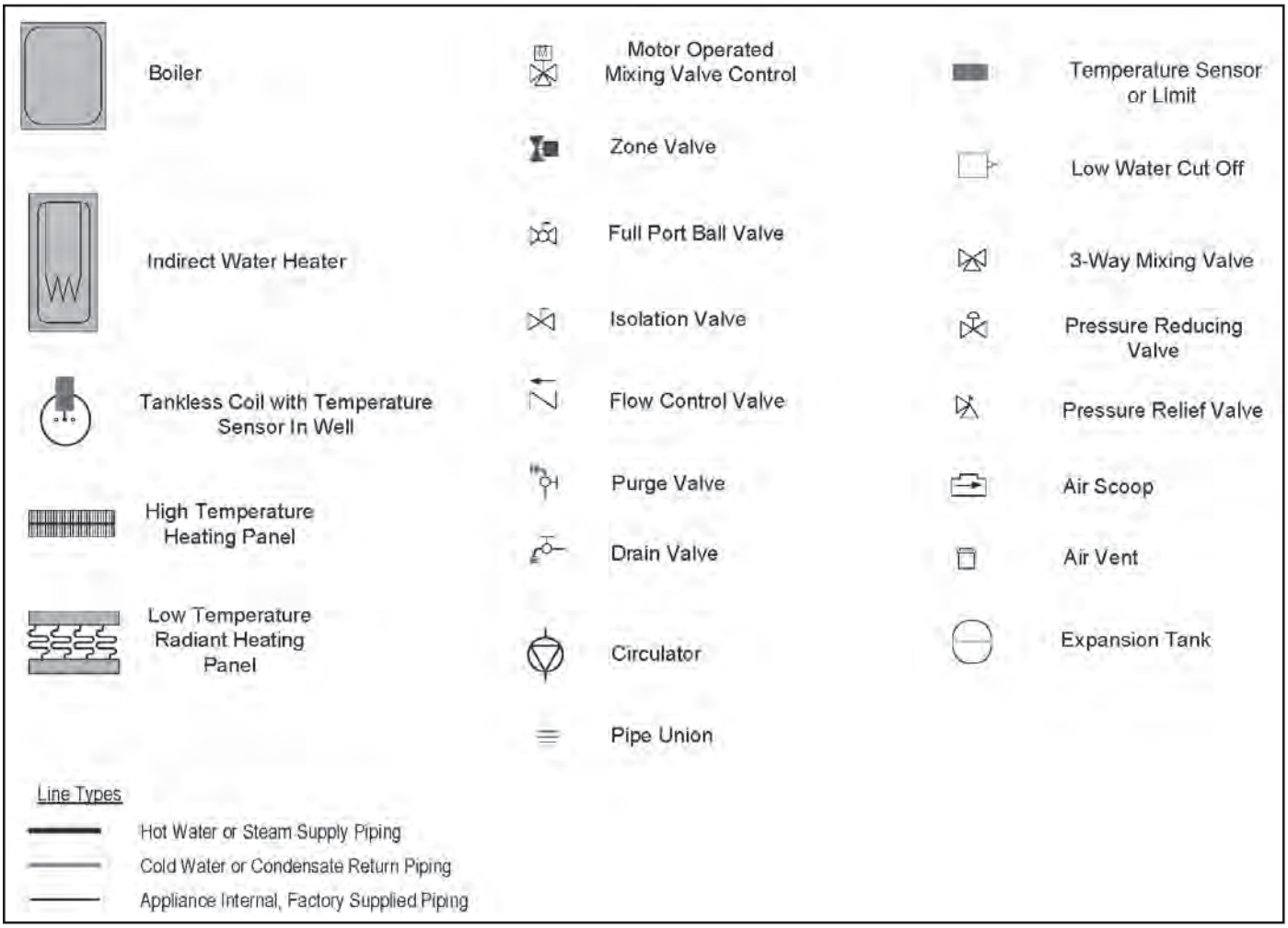


Figure D-0: Piping Schematic Symbols

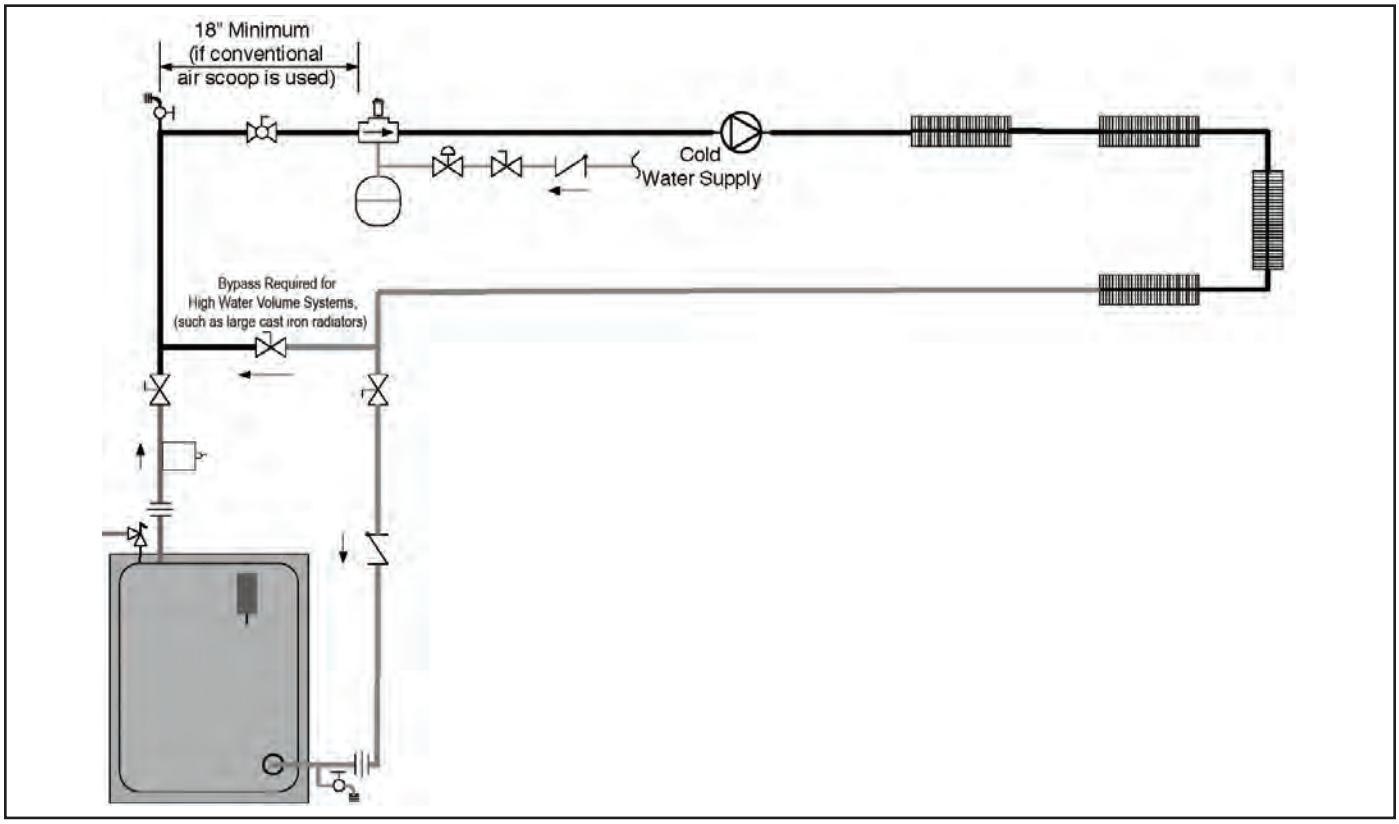


Figure D-W1: Water Boiler, Series Loop

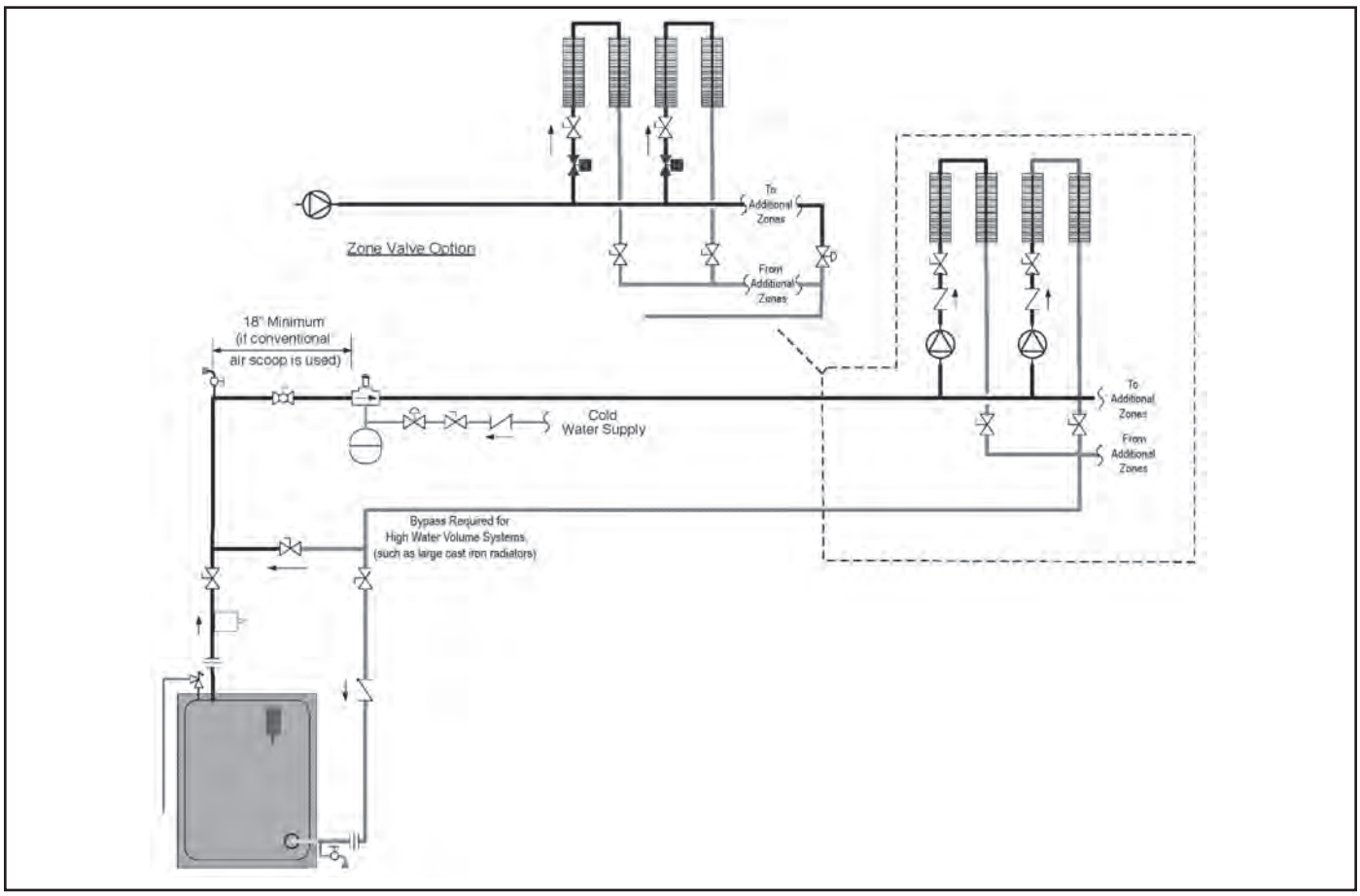


Figure D-W2: Water Boiler, Two or More Zones

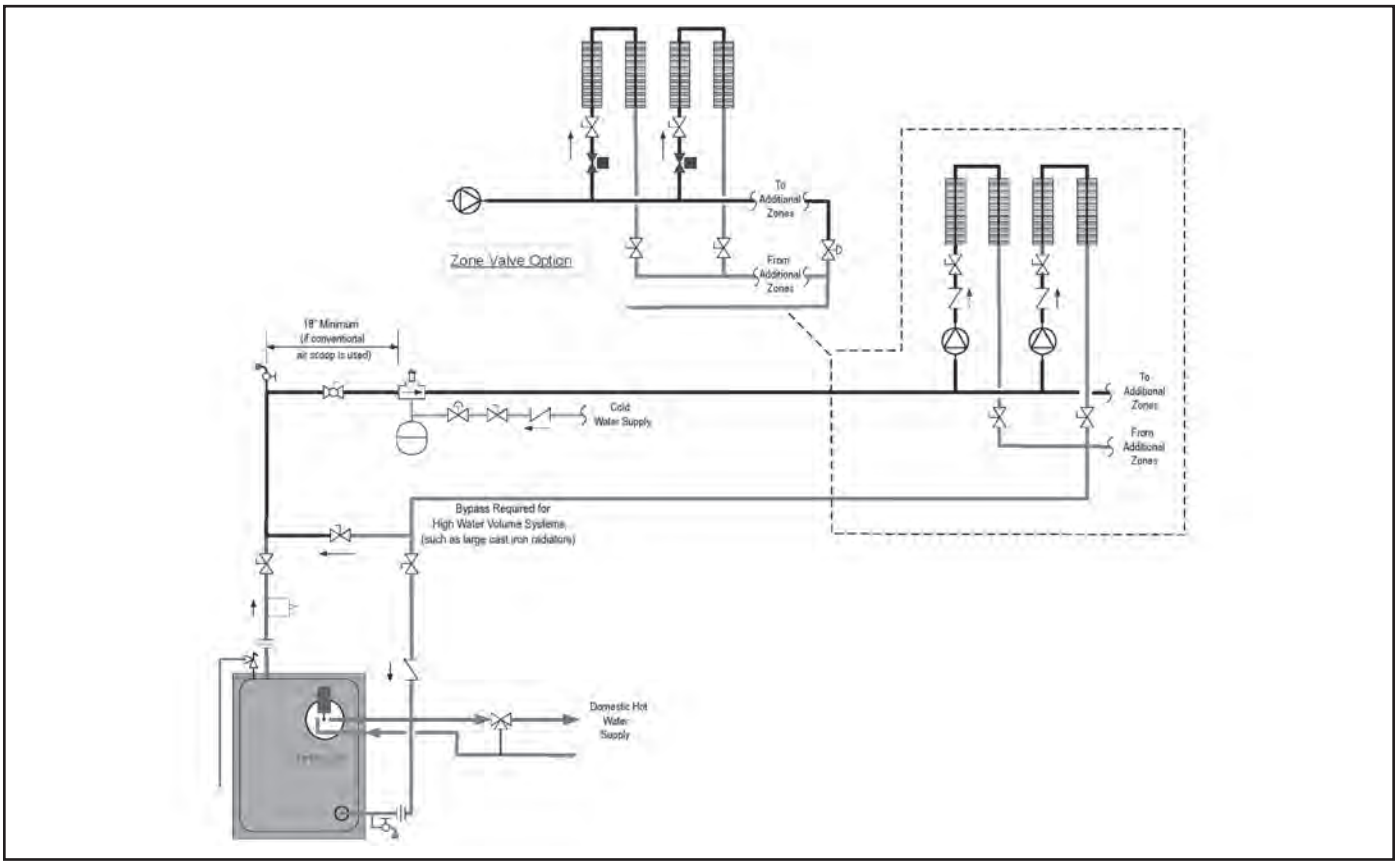

To Additional Zones
Zone Valve Option
From Additional Zones
18" Minimum (if conventional air scoop is used)
Cold Water Supply
To Additional Zones
From Additional Zones
Bypass Required for High Water Volume Systems (such as large cast iron radiators)
Domestic Hot Water Supply

Figure D-W3: Water Boiler, Tankless Coil, Two or More Zones

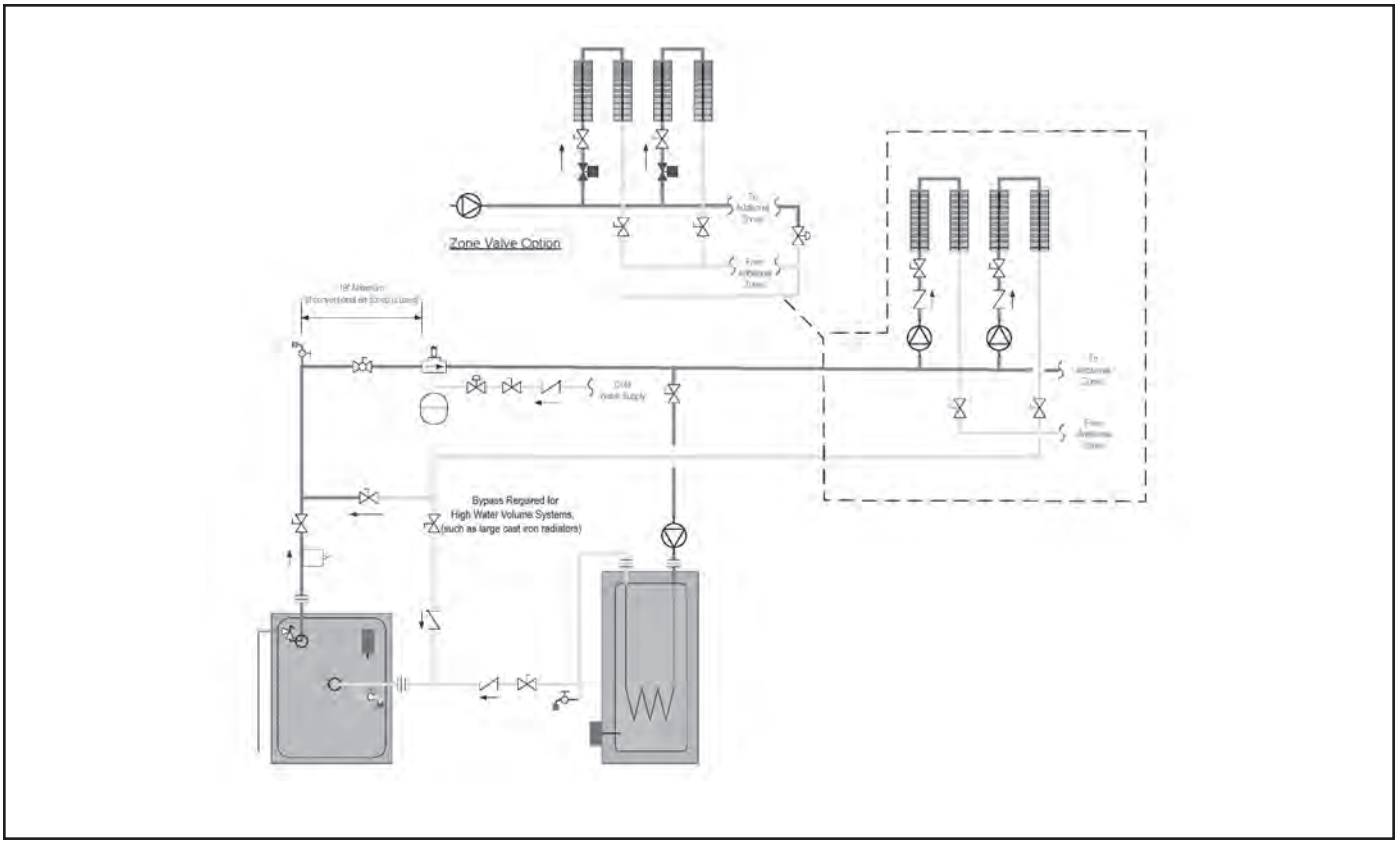


Figure D-W4: Water Boiler, Indirect Water Heater, Two or More Zones

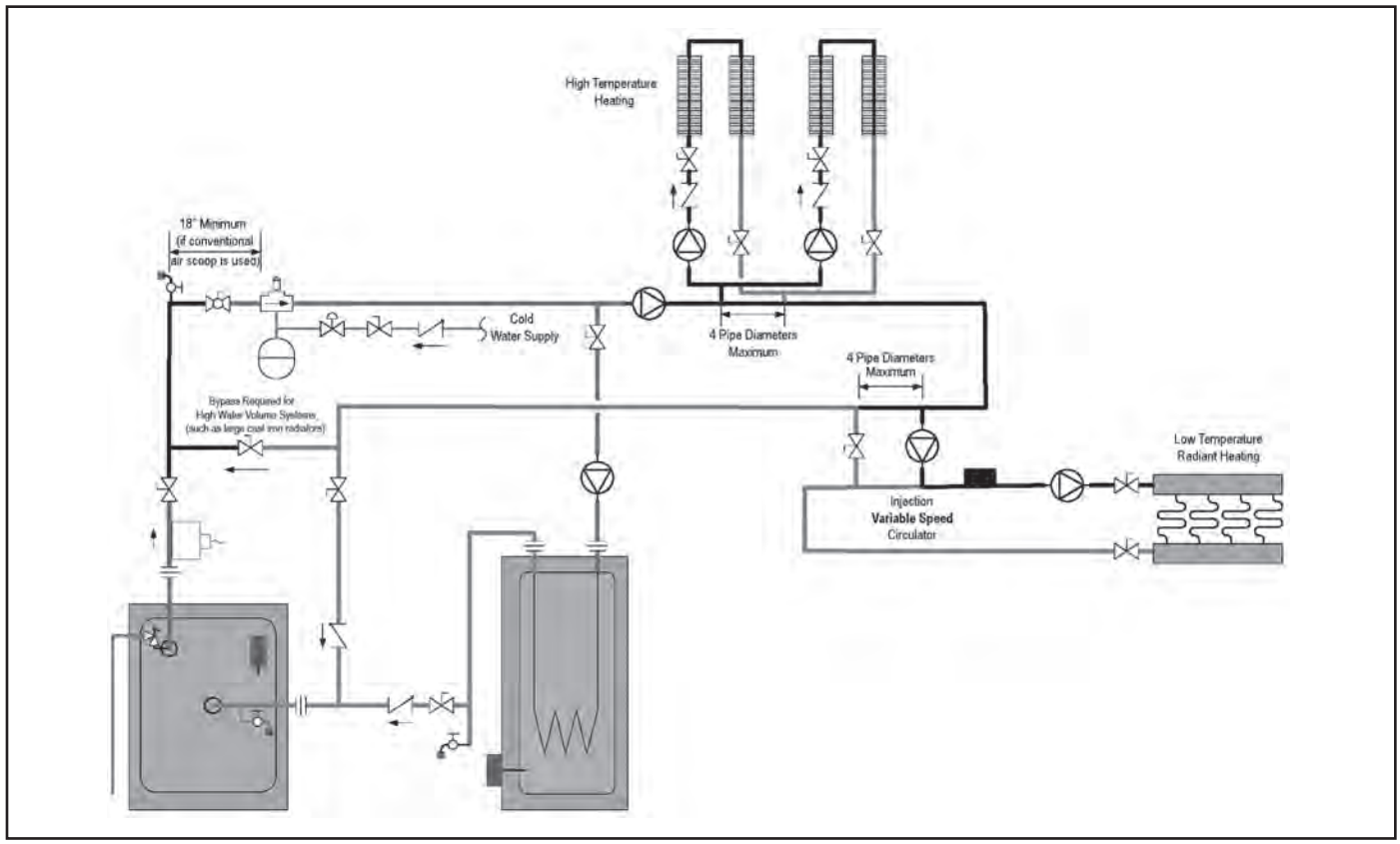

High Temperature Heating
18" Minimum (if conventional air scoop is used)
Cold Water Supply
4 Pipe Diameters Maximum
4 Pipe Diameters Maximum
Bypass Required for High Water Volume Systems (such as large cast iron radiators)
Low Temperature Radiant Heating
Injection Variable Speed Circulator

Figure D-W5: Water Boiler, Indirect Water Heater

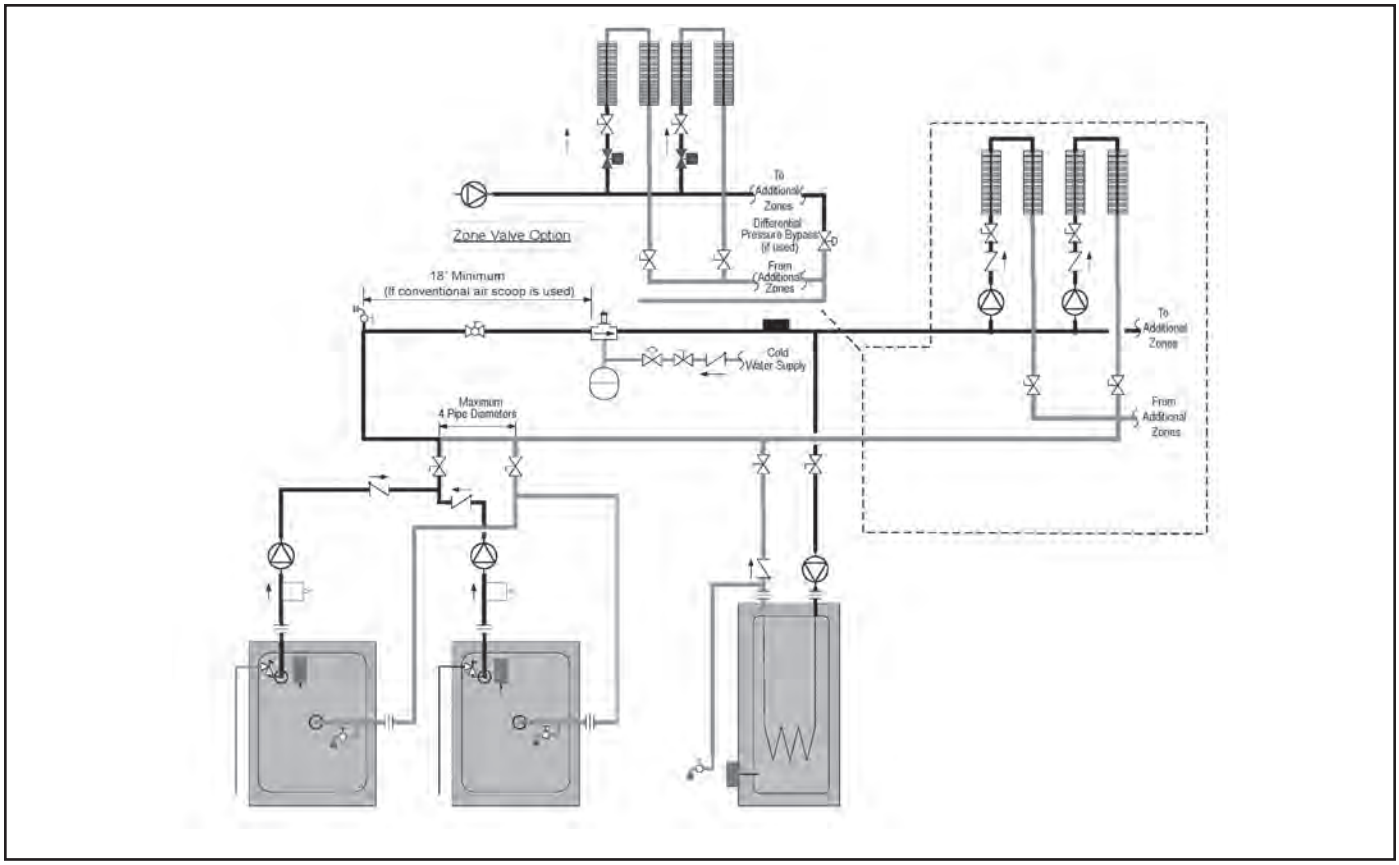


Figure D-W6: Multiple Water Boilers, Indirect Water Heater, Two or More Zones

APPENDIX E – FILLING THE SYSTEM AND CHECKING FOR LEAKS

Fill entire heating system with water and vent air from system. Use the following procedure on a Series Loop or multi-zoned system installed as per the figure below. Remove air from system when filling.

1. Close full port ball valve located between vertical hose bib and air scoop in boiler supply piping (see *Appendix D – System Piping.*
2. Isolate all zones by closing zone valves or shut-off valves in supply and return of each zone(s).
3. Attach a hose to the vertical hose bib located prior to the full port ball valve in the system supply piping.

> **i** *Terminate hose in five-gallon bucket at a suitable floor drain or outdoor area.*

4. Starting with one circuit at a time, open zone valve or shut-off valve in system supply and return piping.
5. Open hose bib.
6. Open fill valve (Make-up water line should be located directly after full port ball valve in system supply piping between air scoop and expansion tank).
7. Allow water to overflow from bucket until discharge from hose is bubble free for 30 seconds.
8. Close hose bib, continue filling the system until the pressure gauge reads 12 psi. Close fill valve.
9. Starting with the first convector in the loop, open air vent to purge air until a steady stream of water flows into container for approximately 5 seconds. Proceed to next convector and repeat procedure until all convectors in the loop are purged of air
10. Close the opened zone valve or shut-off valve for the zone being purged of air.
11. Open the zone valve or shut-off valve for the next zone to be purged. Repeat the previous steps until all zones have been purged. At completion, open all zone valves or shut-off valves.
12. Close hose bib, continue filling the system until the pressure gauge reads 12 psi. Close fill valve.

> **i** *If make-up water line is equipped with pressure reducing valve, system will automatically fill to 12 psi. Follow fill valve manufacturer's instructions.*

13. Open isolation valve in boiler supply piping.
14. Remove hose from hose bib.

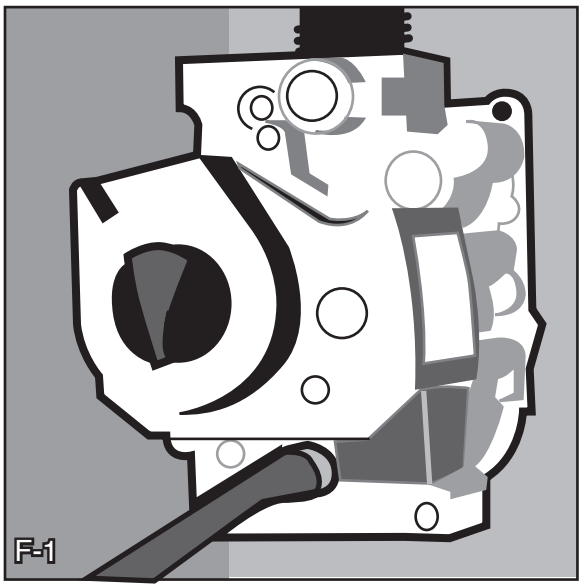
Confirm that the boiler and system have no water leaks.

1. Check Rating Label for maximum operating pressure of this boiler. Never exceed this pressure during leak test. Do not plug or change pressure relief valve. Perform visual inspection for leaks or weeping joints after initial fill and during boiler warm-up period. Repair all leaks before placing boiler into permanent operation.
2. If it is required to perform a long-term pressure leak test of the hydronic system, the boiler should first be isolated to avoid a pressure loss due to the escape of air trapped in the boiler.
3. To perform a long-term pressure test including the boiler, all trapped air must be removed from the boiler and system as prescribed above. A loss of pressure during such a test, with no visible leakage, is an indication that the boiler or system contained trapped air.

APPENDIX F – ADJUSTING GAS INPUT RATE

Natural Gas Boilers:

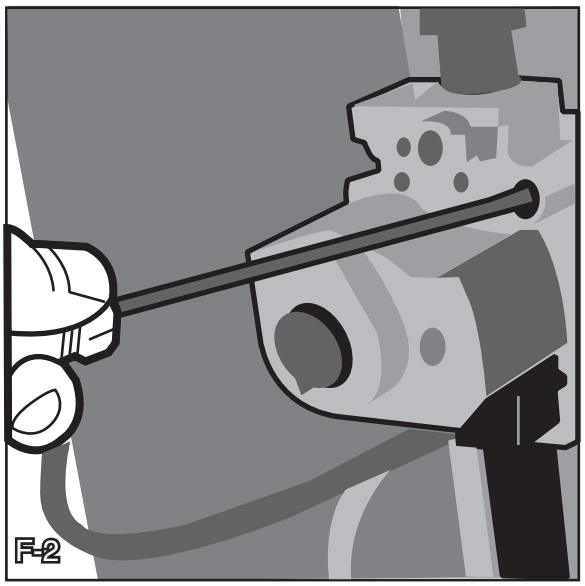
1. Turn off gas supply to all appliances other than gas-fired boiler.
2. Note the rated manifold gas pressure listed on the boiler's rating label.
3. Connect Manometer to manifold pressure tapping on Gas Valve (Figure F-1).


F-1

4. Light main burners by adjusting thermostat to highest setting.
5. If required, adjust gas manifold pressure to the rated setting by turning the gas valves adjustment screw clockwise to decrease manifold pressure or counterclockwise to increase manifold pressure (Figure F-2). Several turns may be required.

Do not force the adjustment screw.

6. On models using more than one gas valve, turn "off" the gas valve not having pilot control and first adjust the gas valve with pilot control. Then, turn "on" both gas valves and adjust the gas valve without pilot control.
7. Clock gas meter for at least two (2) revolutions of the dial typically labeled ½ or 1 cubic foot per revolution on a residential gas meter.


F-2

8. Determine gas flow rate in Cubic Feet per Hour based on elapsed time for two revolutions. (Example: 70 Seconds for (2) Revolutions = 102.8 Cu. Ft.
9. When the clocked time falls between two table values (Table F-1), add the table values shown above and below your clocked reading and divide by 2 (Example: 68 Seconds for (2) Revolutions = (110.7+102.8) /2 = 106.7 Cu. Ft./Hr.).
10. Obtain gas-heating value (Btu per cubic foot) from gas supplier or use nominal value of 1000 Btu per cubic foot.
11. Multiply gas flow rate by gas heating value. (Example: 70 Seconds for (2) Revolutions = 120.8 Cu. Ft./Hr. X 1027 Btu/Cu. Ft. = 124,061 Btu/ Hr.
12. Compare measured input rate to input rate stated on rating label.

DO NOT EXCEED the boiler's rated gas input.

13. If input is too high, reduce input rate by decreasing manifold pressure. Do not reduce more than 0.3" w.c. Instead, contact U.S. Boiler Company for an orifice replacement kit.
14. If input is below 98% of Rating Label input, increase manifold gas pressure no more than 0.3 inches w.c. If measured rate is still

Table F-1: Gas Flow Rate in Cu. Ft. / Hr.

Seconds for Two (2) Revolutions	Size of Gas Meter Dial		
	One-Half Cu. Ft.	One Cu. Ft.	Two Cu. Ft.
24	150.0	300.0	450.0
26	138.4	276.9	415.3
28	128.5	257.1	385.7
30	120.0	240.0	360.0
34	105.8	211.7	317.6
38	94.7	189.4	284.2
42	85.7	171.4	257.1
46	78.2	156.5	234.7
50	72.0	144.0	216.0
55	65.4	130.9	196.3
60	60.0	120.0	180.0
65	55.3	110.7	166.1
70	51.4	102.8	154.2
80	45.0	90.0	135.0
90	40.0	80.0	120.0
100	36.0	72.0	108.0
120	30.0	60.0	90.0
140	25.7	51.4	77.1
160	22.5	47.0	67.5
180	20.0	40.0	60.0
200	18.0	36.0	54.0

less than 98% of rated input, replace or re-drill existing main burner gas orifices:

(1) Remove Main Burners per procedure in Boiler Service instructions in Section (X).

(2) Remove gas orifices. Drill each orifice one (1) drill size larger (drill size is stamped on orifice).

(3) Reinstall gas orifices and main burner. Repeat procedure to measure input rate.

15. Recheck Main Burner Flame.

16. Return other gas-fired appliances to previous condition of use.

LP/Propane Gas Boilers:

1. Follow the procedure for gas boilers, except:

2. Adjust tank regulator for gas valve inlet pressure of 13.5 inches w.c. or less, but not less than 11.5 inches w.c.

3. Gas valve has step-opening regulator, which initially opens to 1.4 to 2.5 inches w.c. and steps to full pressure after approximately 30 seconds. Check manifold pressure after step has occurred.

Leak Test Gas Piping:

THE BOILER AND ITS GAS CONNECTIONS must be leak tested and leak free before placing boiler in operation.

FOR LEAK TESTING OVER ½ PSIG, disconnect boiler and its individual shut-off valve from gas supply piping.

1. For testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shut-off valve.

2. Check for gas leaks in all piping joints, valves, and fittings using a non-corrosive leak detection solution or an electronic leak detector.

3. Repair any leaks.

APPENDIX G – CHECKING DRAFT AND COMBUSTION

CHECK DRAFT (GAS BOILERS WITH DRAFT HOODS)

1. Insofar as is practical, close all doors and windows in the building.
2. Turn on all appliances not connected to the same venting system as the boiler being checked.
3. Turn on all exhaust fans (such as range hoods and bathroom exhausts) to their maximum speed. Do not turn on any summer exhaust fans.
4. Close all fireplace dampers.
5. Operate the appliance being checked. Follow lighting instructions.
6. After 5 minutes of main burner operation, test for spillage at the draft hood relief opening, using a lighted match, candle, cigarette, etc.
7. Repeat this test for each appliance connected to the common venting system.
8. If any appliance does not vent properly, per the above test, make corrections, so that the installation conforms to the *National Fuel Gas Code*, *NFPA 54/ANSI Z223.1*, and/or *Installation Codes*, *CAN/CSA B149.1.*
9. Return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous condition of use.

CHECK DRAFT (OIL BOILERS)

1. Use a manometer precise to 0.01" water column.
2. Fire the boiler until the chimney/vent reaches normal operating temperature.
3. Locate the pressure sensing tapping on the boiler.
4. While the boiler is still firing, use the manometer to measure the draft at the pressure tapping.
5. Confirm that the draft measurement matches the required draft specified for the boiler.
6. If the required draft is not present, make any necessary adjustments and check again.

CHECK COMBUSTION

1. Use a flue gas analyzer that accurately measures CO_2, O_2, CO, and flue gas temperature.
2. For oil boilers, also use a smoke tester with smoke test paper.
3. Operate the boiler at its rated (high fire) input.
4. With the analyzer, check the CO_2 (or O_2), CO and temperature of the flue gases exiting the boiler.
5. For two-stage or modulating boilers, also check the CO_2 (or O_2), CO and temperature of the flue gases at low fire.
6. Confirm that the measured CO_2 (or O_2) matches the required CO_2 (or O_2) specified for the boiler.
7. For oil boilers, also take a smoke measurement of the flue gases. Smoke should not exceed #1.

If CO_2, O_2, or CO fall outside of the range specified for the boiler, review the installation and startup instructions and make any necessary adjustments to the boiler or associated venting or piping systems.

Note the gross flue gas temperature for future reference. Significant changes in flue gas temperature can indicate changes in the boiler's operating efficiency.

APPENDIX H – IQ CONTROL SYSTEM

IQ Control System Overview

The “IQ Control System” consists of an IQ Boiler Control and an IQ Option Panel with optional “plug in” cards:

- Fully integrates both factory and field installed components, simplifying installation and troubleshooting.
- Efficiently operates the entire boiler system to save energy.
- Ensures adequate heat and supply of domestic hot water.
- UL / CSA Listed or Recognized and tested as part of a complete system.
- Communicate with other EnviraCom™ enabled components to provide a complete system solution to maximize comfort and energy efficiency.

IQ Boiler Control: P/N 102290-01

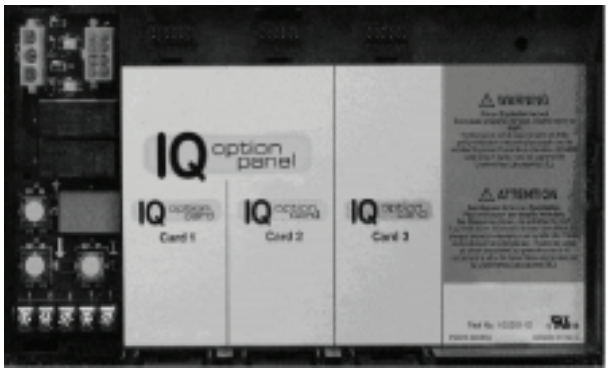
The heart of IQ Control System is the IQ Boiler Control. The IQ Boiler Control replaces the traditional separate ignition control, primary boiler aquastat, as well as the fan and circulator relays.

The IQ Boiler Control stores two boiler supply temperature setpoints in its memory; one setpoint is for the High Limit Setting and the second is for the Operating Setpoint.

When the optional Outdoor Air Reset Card is installed in the IQ Option Panel, the Operating Setpoint temperature is automatically adjusted according to the outdoor temperature. For example, as the outdoor temperature increases the Operating Setpoint temperature is reduced from the High Limit Setting to save energy while improving home comfort. By better matching boiler heat supply to actual home heat demand, room air temperatures are more closely maintained. In addition, when there is a domestic hot water (DWH) heat request, the Operating Setpoint temperature is automatically adjusted to a DHW Setpoint to satisfy the DWH heating requirements. When the Outdoor Air Reset Card is not installed the Operating Setpoint equals High Limit Setting.

IQ Option Panel: P/N 102291-01

The IQ Option Panel works together with the IQ Oil Boiler Control to provide an easy and convenient means to add factory-engineered auxiliary boiler control features. When installed into the IQ Option Panel, IQ Option Cards provide plug-'n-play high temperature limit, low water cut-off and outdoor reset controls. A separate 3-digit LED readout displays settings, status and diagnostic information for all installed IQ Option Cards making them simpler and functionally superior to stand alone auxiliary controls. IQ Option Cards are available for the following features:



- Outdoor Air Reset with Domestic Hot Water Demand
- Auxiliary High Temperature Limit (available in auto reset or manual reset versions)
- Low Water Cut-off (available in auto reset or manual reset versions)

IQ Outdoor Reset Option Card: P/N 102723-01

Installing the IQ Outdoor Reset Option Card is the simplest way to maximize the efficiency of any ESC Boiler. The IQ Outdoor Reset Card is a microprocessor-based control that regulates the water temperature of the heating system based on the outdoor temperature. By modulating the water temperature of the heating system, the ESC Boiler equipped with an IQ Outdoor Reset Option Card will deliver annual fuel savings up to 16%, while increasing home comfort. The IQ Outdoor Reset Option Card is simple to set up yet it includes a powerful list of features that can be customized for any job.

IQ Oil Boiler Control Operating Setpoint is normally set to the High Limit Setpoint. However, when an IQ Outdoor Reset Option Card is installed the Operating Setpoint may be reduced to the outdoor reset or Domestic Hot Water (DHW) Setpoint. When an IQ Outdoor Reset Option Card is added the following user defined setpoints are available:

- High Limit Setpoint - The High Limit becomes the upper limit for the operating setpoint. The operating setpoint can not be set higher than this value. The High Limit is set to protect the boiler and hydronic system from excessive temperature.
- DHW Setpoint - The Operating Setpoint is set to the DHW Setpoint when the Outdoor Reset Option Card DHW input is energized. This setpoint is set equal to the Indirect Water Heater manufacturer's recommended water temperature.
- High Boiler Water Temperature - The High Boiler Water Temperature (also known as the "Boiler Water Design Temperature") setpoint is set to the lowest boiler water temperature that will heat the home on the home's design day. This adjustment typically depends on the type and quantity radiation (heating element) installed in the home.

Kit Includes:
- IQ Outdoor Reset Option Card
- Outdoor temperature sensor w/mounting bracket & 60” lead
- Instructions

Major Features:
- Selectable DHWP
- Selectable/adjustable DHWP protection
- Selectable/adjustable boost feature
- Simple adjustment of reset curve

IQ LWCO Option Card (Auto Reset): P/N 102711-01
IQ LWCO Option Card (Manual Reset): P/N 102714-01

IQ LWCO Option Cards add a low water cut-off function to ESC Boilers. LWCO Option Cards plug into the IQ Option Panel and connect to the system-mounted sensor with a single-wire connection. IQ LWCO Option Cards feature built-in diagnostics, probe signal strength display, and include a “Test” and “Reset” feature in compliance with UL 353 and CSA 22.2 for CSD-1 Compliance in US and Canada.

Kit Includes:
- IQ LWCO Option Card
- 3/4” NPT level sensor
- 36” wire sensor connector
- Instructions

Major Features:
- UL 353 approved
- Displays signal strength
- Warns when probe cleaning required

APPENDIX H – IQ Control System (continued)

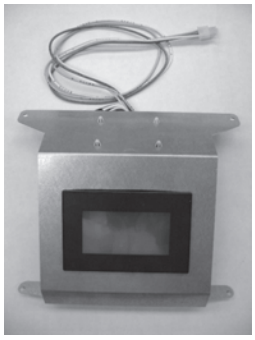
IQ Hi Limit Option Card (Auto Reset): P/N 102717-01
IQ Hi Limit Option Card (Manual Reset): P/N 102720-01

IQ High Limit Option Cards add auxiliary temperature limit-rated controls to ESC Boilers. High Limit Option Cards plug into the IQ Option Panel and connect to a system-mounted probe with a single Molex connection. IQ High Limit Option Cards feature an adjustable set point and differential, as well as built-in diagnostics. Manual Reset models are UL 353 for CSD-1 Compliance in US and Canada.

Kit Includes:
- High Limit Option Card
- Limit-rated probe with 36” lead
- 1/2” well
- Probe retainer clip
- Instructions

Major Features:
- UL 353 approved
- Error code LED and display
- Temperature display
- Electronic adjustment of high limit and differential

3.5” Touch Screen Display: P/N 102728-01



The Display Kit provides a 3.5” LCD multi-color Touch Screen display for mounting in the plastic “hood” above the front door of any ESC Boiler. The Display Kit communicates with the IQ Boiler Control and all installed IQ Option Cards. All boiler settings, status, and errors are displayed in full text on the bright, backlit display. All adjustments are password protected to prevent unauthorized access. Display will turn red and flash in the event of a boiler error or lock-out. Display features full-text explanations of all features and settings, as well as help screens with diagnostics and troubleshooting information.

Kit Includes:
- 3/4” Multi-color LCD touch screen
- Display software
- Enviracom gateway
- Wiring harness connectors
- Mounting bracket
- Instructions

Major Features:
- Fully assembled kit requires only 4 mounting screws and a single Molex type connection
- Adjusts all Outdoor Reset IQ Option Card parameters with graphics and help information screens
- Full English descriptive alarm displays with Recommended Corrective Action
- Real time trend displays
- Extensive Help screens to aid understanding of terminology and setup

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EnviraCOM Thermostats:

Connected thermostats provide a red LED and display the IQ Oil Boiler Control, Primary Control or IQ Option Card Error Codes. A home owner is alerted to a problem even before the water is cold. When an Outdoor Reset card is installed with a setback thermostat, “leave” or “sleep” modes are used to shifts the reset curve to save energy while the home is in a reduced room temperature mode.

Honeywell VisionPro IAQ Setback Thermostat
(Honeywell P/N TH942lc1004)

APPENDIX H – IQ Control System (continued)

System Parts List

Optional Components

Part Number	Item Description
102723-01	**Outside Reset** IQ Option Card, Domestic Hot Water Priority, for use with Option Control Panel, with Outside Air Temperature Sensor, Instructions, Unit Pack
102294-01	**Outdoor Reset** IQ Option Card, Domestic Hot Water Priority, for use with IQ Option Panel, less Sensor
102439-01	Outdoor Air Temperature Sensor, 12k ohm
102711-01	**LWCO** IQ Option Card kit, Hot Water LF Module, Automatic Reset, for use with Option Control Panel, with Probe, ¾ inch NPT, Instructions, Unit Pack
102714-01	**LWCO** IQ Option Card kit, Hot Water LF Module, Manual Reset, for use with Option Control Panel, with Probe, ¾ inch NPT, Instructions, Unit Pack
102305-01	**LWCO** Probe, ¾ inch NPT
102720-01	**Aquastat** IQ Option Card, 130-220 Deg F, Manual Reset for use with Option Control Panel, Temperature Sensor, Well, Sensor Clip, Instructions, Unit Pack
102717-01	**Aquastat**, IQ Option Card, 130-220 Deg F, 15 Deg F Adjustable Differential, Auto Reset, for use with Option Control Panel, Temperature Sensor, Well, Sensor Clip, Instructions, Unit Pack
102292-01	**Aquastat** IQ Option Card, 130-220 Deg F, Manual Reset for use with IQ Option Panel, less well, Less Sensor
102293-01	**Aquastat**, IQ Option Card, 130-220 Deg F, 15 Deg F Adjustable Differential, Auto Reset, for use with IQ Option Panel, less Well, less Sensor
102295-01	Limit Rated Temperature Sensor, 36 inch length
102296-01	Limit Rated Temperature Sensor, 48 inch length
102728-01	**IQ LCD Display**, Boiler Exterior Mounted, STN Monochrome, White/Red backlight, 5Vdc Power Supply, RS422 (RS485) Communication, Pure Black Bezel with Gateway, Wire Harness, Mounting Bracket, ES2 Logo Plates and Instructions
102725-01	**IQ LCD Display**, Boiler Exterior Mounted, STN Monochrome, White/Red backlight, 5Vdc Power Supply, RS422 (RS485) Communication, Pure Black Bezel
102495-01	Enviracom/Modbus RS422 Gateway and 5 Vdc Power Supply for Communication Between the IQ Controls and LCD Display, 24 Vac Power Supply Input

Additional Information List

Aquastat IQ Option Card Instruction Sheet - part number 103589-01
Outdoor Reset IQ Option Card Instruction Sheet - part number 103590-01
Low Water Cut-off IQ Option Card Instruction Sheet - part number 103591-01
LCD Display Kit - part number 103592-01

SERVICE RECORD

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